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Electrical

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THE ELECTRICIAN.

Vol. II. - No. 1.] JANUARY, 1883. [$1.00 a Year. 10 Cents a Copy.

ELECTRICITY AT SEA.

WITH the increase in the number of steamers and sailing vessels, the danger from collision has enormously increased, the more so that the majority of steamer lines, etc., choose the same ocean "lane." The danger is rendered far greater by the notoriously defective illuminating apparatus; many accidents being caused by the very confusion of lights—green, blue, red, etc.—that give but an imperfect idea even of the position of, and the direction in which a vessel may be moving. The lights are seen, but as lights without any illuminating power. The adoption of the electric light would certainly prove of the greatest benefit. Steamers having the electric lamp would not only have an illuminated lane before them, but would form ocean lighthouses to other vessels, thus preventing the very possibility of collision. It may well be asked why this safeguard has not been adopted; why its use has not been made imperative? The accident to the "Alaska" seems to have given the owners the idea of having the Guion steamers provided with the electric light; oil and candles being totally tabooed

ELECTRICITY AT SEA.

The French steamers were pioneers in this commendable introduction of electricity; and, owing to recent improvements in lamps—especially by Serrin—the luminous rays can be perfectly controlled. The engraving shows in a striking manner, the danger on the one side, and the remedy on the other. The huge ice mountains remain as ever in the frozen North, and are ready as ever to crush the puny might of man, unless the inventions that make him almost superior to nature are made available.

NEW TELEPHONIC APPARATUS.

EVERY day we see new forms of telephones, which are naturally regarded, by their authors, as superior to all that have preceded them.

It is so difficult to appreciate the slight differences which distinguish between the effects of one telephone and those of another, that comparisons are very uncertain, and when superiority is claimed, care must be taken, before admitting it, to fully understand in what it consists. By some it is recognized in the greater intensity of sounds produced, by others in the perfect clearness, natural quality or "timbre" of the reproduced voice, simplicity of construction, ease of installation, or low cost. When well regulated, the differences presented by these different apparatuses, are, perhaps less important than is generally believed, and I think that the perfection claimed for them is often due simply to accuracy of construction. However this may be, it is interesting to follow the reasoning, more or less specious, upon which a claim of improvement is founded, and it is always with pleasure that we describe an apparatus based upon a new idea.

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TELEPHONE OF MR. GOLOUBITZKY.

Among the apparatus of this kind, that this journal has not already described, may be presented that of Mr. Goloubitzky, which, admirably constructed by Mr. Leuczewsky, has afforded important results.

Starting from the fact that several telephones, placed at a receiving station, can without sensible loss of sound in any of them, simultaneously reproduce the speaker's voice, Mr. Goloubitzky conceived that by condensing all of them in one, an instrument might be contrived which would produce more powerful sounds.

The idea led him to think that several magnets, simultaneously acting upon the same diaphragm, might solve the problem, but it would be necessary that the vibrations produced by them should be concordant, and not give origin to interferences of the sonorous waves. It seemed to him that the individual action of each of these several magnets, acting in unison upon a single membrane, must aid the others to augment the vibration, and that, in a proportion as much greater, as its influence is exerted upon a larger surface, and moreover, upon a membrane already set in motion by similar neighboring influences.

Recollecting that if in the mechanism of a clock the isochronism of its movements be regulated by one of the branches of a diapason, and that if, even a powerful exterior cause, intervene to destroy this isochronism, the vibration of the other branch, which is free, suffices to maintain it. The synchronism of the autographic telegraph of Mr. d'Arlincourt, which is so perfect, is based upon this principle. Therefore, in admitting that the resistance of the diaphragm in some one of its parts, might possibly restrict the amplitude of the vibration determined by one of the magnets, a second, a third, or even a fourth magnet vibrating it in the same manner, should tend to amplify the normal vibration, and this action must be as much more effectual as it is exerted upon a body already put in motion.

Since the presence of several magnets before a diaphragm must divert their polar action from the centre, and since to obtain the maximum of effect it is necessary to have both poles of each magnet act at once, Mr. Goloubitzky inquired what should be the position of these magnets around the central point of the diaphragm, which would be the most favorable to the development of its vibration, and he was thereby led to study the manner in which a telephonic diaphragm vibrates under the influence of sonorous waves resulting from articulate sounds. It appeared certain that to arrange the best conditions he should locate his magnetic poles with reference to the lines of the diaphragm corresponding to its ventral segments, points, whereupon the electro-magnetic action could be the most effectually exerted, since they would correspond to the parts susceptible of being put in motion by influences which would determine the proper vibration of the plate.

His experiments were made, in the beginning, with the box of a large Gower telephone, which was about 17 centimetres (an American five-cent piece is two centimetres), in diameter, and in the base of which was stretched a double membrane of parchment.

Projecting in the acoustic tube, a sonorous wave, the first membrane would be vibrated and transmit its vibrations to the second by the intermediation of the film of air between the two membranes. Now, when upon the second membrane some powdered lycopodium was dusted it was expected to indicate, by its distribution upon the surface, the nodal and ventral areas of the first or acting membrane corresponding to any special sound. It is unnecessary to add that the experiments were extraordinarily delicate.

By speaking in the acoustic tube the different letters of the alphabet, Mr. Goloubitzky obtained a series of figures which he has related to a diameter of membrane divided in 17 equal corresponding parts of 1 centimetre each, (half the diameter of a five-cent piece) in order that they may be easily described.

"For the letter *e*, says he, the centre of the membrane constitutes a *node* where no vibration occurs, and around this centre extends an annular region, two divisions and a half (or two and a half centimetres) in width. This again is circumscribed by an annular space of from 2½ to 3 divisions in width, corresponding to a new node, which again is encircled by a new zone of vibration extending to the border of the membrane, and from 2½ to 3 divisions in width.

"From these figures it results, that at a distance of about 2½ centimetres from the centre of the membrane—that is to say, about in its median region, occurs an almost inert annular space, which, however, is not homogeneous in all its parts, for the lycopodium forms within it certain circular and elliptic accumulations, exceedingly complicated, which indicate points of minimum vibration; disposed undoubtedly in a definite order, but which, from default of photographic reproductions, I have not had the leisure to study from a scientific point of view. I am able, however, to conclude from these experiments, incomplete as they undoubtedly are, that a circular vibrating plate has a node at its centre, and that the region adjoining this centre, where the vibrations are most easily manifested, is an annular ring about 2½ centimetres (1 inch) wide.

"For the letter *e*, spoken in the tube, the little heaps of lycopodium powder in the space corresponding to the annular node, formed two large ellipses in one direction, and two small circles in the perpendicular direction. The central circle was distinguished by a dozen little heaps of the powder, arranged symmetrically around it. For the letter *o*, the figure was very nearly the same as for the letter *e*, at least as respects the central part, but the annular node presented its elipsoidal figure more greatly extended, and the little circular figures disappeared, when the sound was loud and strong, and so completely that the ring then plainly resembled a printed letter *O*.

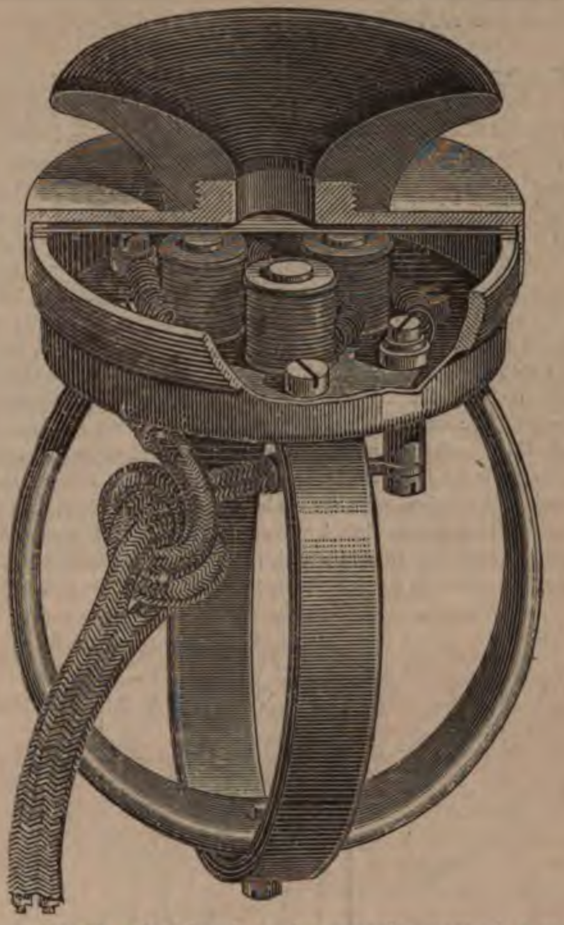
"The figure corresponding to the combination of letters *ou*, showed around the central spot a series of little circular spots, as with the letter *e*; but they were disposed in groups of five at the opposite extremities of the same diameter, being in groups of two only upon each side, on the line of the perpendicular diameter. The sound of the letter *i*, gave rise to a great many little circular spots in the central part, which were surrounded by a more compact part, around which, again, many little circular spots were developed. For the word 'allons' (go on), the vibration was very feeble, and extended only to a distance of two centimetres (about ¾ of an inch) from the centre of the plate. It was hardly visible near the circumference. For the word 'attendez' (wait), the figure somewhat resembled that of the letter *a*. I have, further, more than once noticed, that for loud sounds, the little circular spots became elongated and flattened, which indicated that the nodes augmented in size, while for low tones, on the contrary, they became more convex and reduced in diameter.

" The difficulty of reproducing these figures without the aid of photography, has hindered me from continuing the study; but my experiments have sufficed me to decide upon that which I wished to know, relating to the best disposition for a telephonic combination, and convinced me that the inert part of the centre of a telephonic diaphragm can, sometimes, attain more than one centimetre (2-5 of an inch) in diameter, while the part where the vibrations are propagated occupies the median portion of the plate, at about one-third of its diameter. Now, this demonstrated to me that I could, advantageously, remove my magnets from the centre of the diaphragm."

In accordance with his preceding considerations, Mr. Goloubitzky arranged before the two telephonic diaphragms, and within the annular region, corresponding to their vibrating segments, the poles of several iron horseshoe magnets, crossing each other, and disposed with relation to each other in different ways; sometimes he made use of four, the poles of which were ranged around the centre of the diaphragm, in the form of a square; sometimes he employed only two, crossed at a right angle, as shown in the annexed figure, in which case the poles form the four angles of a perfect square. This arrangement seemed to be the most economical, and is adopted. The relative disposition of the similar or opposite poles, has also been studied by Mr. Goloubitzky, and that in which a south pole is situated between two north poles, and a north pole between two south poles, appeared to him to give the best results; but to realize these results it was found necessary to charge the magnets before mounting them, as they could be better adjusted with relation to the diaphragm if previously magnetized.

The latter method of construction, in which the two poles, north and south, are arranged, one by the side of the other, presents some advantages, for it permits a more easy magnetizing, since it is then only necessary to rest them, two by two, upon each of the poles, of an active electro-magnet, and to prolong the contact about five minutes; no part need be dismounted or readjusted, and the regulation of the diaphragm is easily effected, for it may be separated from the cylindrical box of the telephone by a narrow rim of copper placed upon its edges, and by more or less unscrewing the cover carrying the telephone mouth-piece; the diaphragm may be given sufficient of play to allow of its suitable separation from the four magnetic poles.

Its adjustment may be regulated by the sound that is heard by tapping on the diaphragm crossing the opening of the embouchure. The bobbins of the electro-magnet were connected in the beginning in such a manner as to correspond to the other two different poles of a single magnet, and the two pair of bobbins were associated in such a manner that the current passed from one through the other in tension.



Mr. Goloubitzky made experiments to assure himself of the power of his apparatus, which, according to his judgment, is superior to that of the best telephone known to date, in the proportion of 120 to 40. We allow him the sole responsibility for this assertion, contenting ourselves with reporting the manner in which he made his comparative experiments. He employed, as transmitter, a microphone of the Gower bell system, upon the plate of which he applied a metallic wire, fixed to the superior part of a metronome. The circuit of the transmitter ended at a commutator, which could put the microphone in circuit successively with several telephones of different kinds furnished with acoustic funnels. Afterwards he successively removed the ear from these trumpets, until the sounds of the metronome, reproduced by them, were no longer perceptible. Now in making the experiment he found that for some it was necessary to remove the ear 20 centimetres, for others 40 centimetres, and for his own 120 centimetres. Having not verified the assertion, I have no more to say regarding the experiment, than, that any one can repeat it at pleasure.

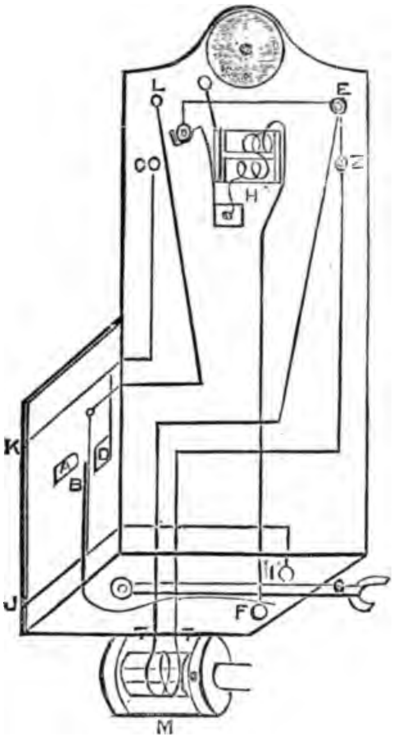
As we see, the apparatus of Mr. Goloubitzky is based upon good reasoning, and this alone recommends it to our attention. We may, however, in time make some experiments with it, which will enable us to form ideas of our own respecting its practical value, and in the meantime we present it as an object of great interest.

TH. DU MONCEL,
In *La Lumière Électrique.*

— THE *Yonkers Gazette* of Dec. 2d., says, that the Yonkers Fuel Gas Company is now putting in an electric lighting station with a capacity of three hundred thousand candle power, which is considered adequate to supply the present demands of Yonkers, Mt. St. Vincent, and Riverdale. The wonderful state of perfection to which this company has brought its system of lighting must insure for it general adoption. Already several of the large establishments on the line of the New York Central and Hudson River Railroad are arranging to put it in; and within a few weeks we may expect to see a continuous blaze of electric light from Mt. St Vincent to Glenwood. We understand that the motive power used by the company is gas engines run by fuel gas, at a cost of 3 cents for gas, per hour, for each lamp, and that the system referred to is the U. S. Electric Lighting Co's.

THE SIMPLEX TELEPHONE.

A CORRESPONDENT, of a foreign cotemporary, sends a sketch of switching for the Simplex Telephone—the front, top, and one side removed to show the connections. It is manipulated as follows :—To call the distant station, press the button *A*, which breaks contact at *B*, and puts the line, *L*, and carbon of battery, *C*, in contact at *D*. The circuit is completed by putting the zinc of battery to *Z*, whence the current passes through the receiver *M*, and out at *E*—either to earth or return wire. By this arrangement the ringing at the distant station is repeated, or made known at the sending station. The contacts at *B*, are made with two strips of hard rolled metal, and continued under the lever *G*, which must be kept down on *F*, while signaling with the bells, but be in contact with *I* when speaking. This is done by hanging the ear-tube on the lever hook, or the Bell receiver, should that be used instead of the electro-magnetic one. In coupling the instrument, the *L* of one is connected with the *E* of the other. The transmitter *T*, swings on two small brackets inside the front, and contact is made at *J* and *K* when the front is closed. The carbon cups are made out of ½ in. carbon, and is best done with a rose countersink, large enough to take half the ball without touching the head of the screw which secures the cup in its place, or the cup may be glued in its place, contact being made by twisting a wire round the outside ; the discs are made with slices of carbon pencil, with a groove round them to have wire twisted, and when the balls are screwed up in the case, they should be quite free to rattle. The cups should be arranged 1 in. apart. An old saw and a file will do all the cutting and shaping, and if you have no lathe, a brace will answer the purpose. In the receiver, a bundle of iron wires takes the place of the permanent magnet, which was devised to meet the case of "Bell's" disclaimer, in which he disclaims a magnet excited by a battery in the line circuit. The adjustment of the diaphragm has to be made before finally screwing up, and will give no trouble if you observe to file the faces of the body of receiver, and the core, a dead level. Then cut a ring of stout writing paper, with the hole about 2 in.; glue one on each side, and when the ferrotype plates are laid on, they will be the right distance from magnet, and may be screwed up. In conclusion I would observe that the instruments switched in this manner are as loud as any made: but they can only be used in pairs, unless a separate switch is used with each instrument to reverse the poles of the battery. But in order to remove that obstacle, I have discovered that if the receiver is formed of a small induction coil, instead of the simple one, then an alternating induced current is produced, without using an induction coil in the instrument. The result of this discovery will be, that any resistance in long lines may be overcome, by simply increasing the battery power to increase the power of the magnet ; the induced current being proportionately strengthened.



THE *Tech*, of Dec. 6th, gives a statement of the original work done in the physical laboratory of the Massachusetts Institute of Technology, during the last year; we quote that part of the article relating to electricity:

As a result of numerous experiments on induction in telephonic circuits, Prof. Cross has found that the induction operating to produce telephonic disturbances, is almost entirely electro-dynamic.

The effect of thin sheets of tin foil, surrounding an insulated conducting wire is very slight. The diminution of inductive effect produced when a plate of metal, or a spare wire, is placed between the wires carrying the inducing and induced currents, was found to be much greater than with the foil, and also greater with the overtones of the sounds transmitted than with the fundamental. That electrostatic induction is almost ineffective, so far as producing sounds in the receiving telephone is concerned, is shown by the fact, that if a small secondary coil with a large and deep primary is held at right angles to its plane, the sound disappears ; also, if the metal plate between the coils is slit radially, its effect in diminishing induction disappears.

If intermittent or variable currents are passed through a coil of wire forming a closed circuit, within which a second closed parallel coil is placed, the secondary current, induced in the latter, can be investigated to a certain extent by inserting a receiving telephone in the secondary circuit. If a closed wire coil is placed near to the other coils, there is a current induced in it, which, as Henry first showed, diminishes the strength of the current in the secondary coil. A heavy sheet of metal, as of brass, placed between the primary and secondary coils, also diminishes the current in the secondary for the same reason. Hence, in both of these cases, the sound produced in the telephone by induction is considerably reduced.

The effect of brass, copper, and iron is very marked. Lead, also, contrary to an opinion that has been advanced, exerts a very decided effect. Thin foil, even if it completely envelops the secondary, produces but slight effect. The application of these important results to telephonic cables is obvious.

If, instead of being placed in a simple secondary coil, the telephone is placed in a double circuit of twisted wires, so arranged that the current induced in these will be in opposite directions, complete neutralization of currents is produced, and consequently cessation of sound.

Various other experiments have been performed to test the value of different "anti-induction" devices.

Prof. Cross has also found that a Hughes microphone, and a Blake transmitter, were capable of transmitting the sound of a high pitch bar giving 12,000 double vibrations per second, thus showing the excessive sensitiveness of the ordinary hand receiving telephone. If the capacity of the line were increased, it was found that its ability to transmit high vibrations was diminished. These experiments also showed that change in quality in the sounds transmitted is not due, as has been stated, to an inability of the microphone, or any part of this circuit, to respond rapidly enough to their higher overtones.

CHEMICAL APPLICATION OF ELECTRICITY.

(*From the Revue Industrielle.*)

OUTSIDE of the galvanoplastic applications of electricity, no attempts seem to have been been hitherto made to utilize the electric current in the reactions of industrial chemistry. Electricians have almost confined their researches to the purposes of illumination, and the transmission of force to a distance, perhaps, because it is easier to strike the imagination of the public under these forms. At the same time there is every reason for supposing that the manufacture of chemical products will not fail to profit by recent discoveries, and that great changes in manufacturing methods will be effected by these new aids. Such laboratory experiments as the decomposition of salts, will, one day, enter into practical manufacture, and render it possible to simplify a costly and cumbersome *material.* The direct production at once of acids and salts will perhaps be realized on a large scale by means of electricity.

Although great sacrifices of time and money may be essential to this realization, there is nothing unreasonable in entertaining such hopes, when we look at the progress that is being made every day, and earnest efforts to this effect are being made abroad.

An item of news, that promises to be of the highest importance in the chemical industry, comes to us from Glasgow University. Dr. Dobbie and Mr. Hutcheson, assistants to the professor of chemistry, have been studying the effects of the passage of an electric current through a solution of common salt. They found that hypo-chlorite of soda was formed. If the solution is neuter, a part of the chlorine is liberated during the passage of the current, and at the same time, hypo-chlorite of soda, which remains undecomposed in the solution, is formed. If the solution is alkaline, the solality of the chloride of sodium seems to be converted into hypo-chlorite, and if it is acid, the hypo-chlorite is immediately decomposed after its formation, the chlorine is liberated, and no more hypo-chlorite remains.

Dobbie and Hutcheson have endeavored to apply their discovery to the production of chlorine for bleaching, and they have been so successful that the process has been tried in a cotton print establishment. The cloth, after being treated with a solution of salt and water, is passed between two carbon cylinders, joined respectively to the two poles of a battery. The current passes through the wet cloth, in the fibre of which, according as the solution is alkaline or acid, hypo-chlorite of soda or chlorine is formed. In the first case a new acidification must be given for the purpose of bleaching; in the latter case the action is immediate. The pieces of cloth are printed by means of cylinders, on which resists are made with an insulating varnish, and thus the current passes only on the parts of the cylinder that are bare.

A great advantage in this process is, that the preparatory washing and scouring of the unbleached cloth may be dispensed with, in a certain degree. The electric current itself facilitates the division, and consequently the carrying off of the resinous matter in the organic fibre. The process should not, however, be further introduced until it is proved that it is commercially practical, but if reports are to be believed, there are great reasons to consider that the methods of bleaching, ordinarily followed, can be greatly modified by electricity.

In another line, we should mention the works of Messrs. Blast and Miest, who claim to have discovered a cheap process of extracting the precious metals from their ores by electrolysis. It consists in substituting plates of compressed sulphureous ore for the negative electrode of electrolytic baths—the salt of the bath having the same metallic base as the metal of the ore. An electric current passing through the bath decomposes the negative electrode, liberating the sulphur which is deposed at the bottom of the vat, while the metal goes to the positive electrode. The metal is thus extracted first from the solution of the bath, which is, however, renewed by the decomposition of the ore of the negative electrode, until complete exhaustion. If the sulphides, or sub-sulphides, contain several metals, it is then necessary to separate these minerals, which is done by the aid of a second or third electric bath.

UTILIZING THE TIDES.

THE use of water as a motive power is, of course, nothing new, but great curiosity has been lately excited by a project, for turning the immense motive power of Niagara Falls to account, and distributing it by means of electricity over a large area. It is one of the peculiarities of electricity, that while it is always able to give, it is always ready to borrow, and, in fact, it would almost seem, that its *rôle* is protean. In this connection it will be interesting to hear of the project of a Frenchman—M. V. Gauchez, for making the motion of the ocean itself a handmaid of electricity. A French writer puts this so well, that we cannot do better than translate his remarks. "The ocean forms an immense reservoir of motive power—the greatest, perhaps, in Nature, but whose energies are wasted. The incessant agitation of its waves, and the oscillation of the tides, are absorbed in polishing the pebbles that are cast on its shores, or modifying at most, the outlines of the coast that they beat against. But here is an enormous power which presents itself, gratuitously, as it were, for it comes from the sun, like everything that we receive, for even coal itself, represents nothing but the solar heat that has been accumulated during ages. The motive power of the sea, like that of running streams, has been the objective point of many inventors, but hitherto no really practical apparatus had been invented for the purpose, while the success of the steam engine completely turned the attention of inventive minds from the question. Still, the steam engine is far from being an economical apparatus, or, even one that is in conformity with the laws of rational mechanism. It cannot be gainsaid that there is a regular waste of power by its use, as not more than ten per cent. of the motive effort expended, is realized. Nor is there any reason to hope for an improvement in this respect, as the maximum theoretical return, determined by the physical properties of steam, is limited to about 20 per cent. The improvements that have been lately made in electric machines, evokes renewed attention to this question of the economic production of force, and now that we possess an intermediary that can transform and utilize at a distance the motions produced by all kinds of appliances; electric motors must in the end dethrone the steam engine, if they can do work without deriving the motive power from it.

The utilization of natural forces is, therefore, destined to play a great part in mechanics, and there is every reason to believe, that the question will receive a definite solution in the near future.

In this connection some details of recent experiments, and more especially of the apparatus of M. Victor Gauchez, which was exhibited at the Brussels Exposition of 1880, will be of interest.

M. de Coligny, the predecessor of M. Gauchez in this line, had succeeded in making use of the oscillatory motion of the sea to raise to a certain height from the water, and the apparatus which he invented was successfully used in draining the lakes bordering on the coast. He simply utilizes the elevation of the level which the water takes when an oscillatory movement is imparted to it, or the "stroke" which is given when a current is suddenly interrupted. If properly handled, his apparatus can economize a volume of water equal to 70 per cent. of the waste of an ordinary sluice, and sometimes even up to 90 per cent., as has been shown by experiments on a sluice in the vicinity of Fourchambault.

Some experiments have also been made with the view of directly utilizing the rising and falling motion of the tides, by storing up the water at high tide in large reservoirs and then by allowing it to flow out at low tide. A mill, with eight runs, has been worked in Finisterre by this method—one, by the way, which, under a different form, has been applied at Alexandria, in Egypt. Attempts to compress the air in large submerged bells, which would be filled with water at high tide, have also been made, but without much success.

But leaving tides out of the question, the very motion of the waves on the surface of the sea, may be made use of. In this case, the requisite apparatus must be put up at a certain distance from the shore, so as not to be subjected to the tides, while on the other hand, the force obtained becomes variable—since it equally depends on the simple swell that but ruffles the surface, to the furious wave that rises to many feet in height, and upsets boats. But this undulatory motion of the wave is easily caught, as it were. It is propagated, in fact, under the same conditions as sound or light, that is, the molecules of water—like the molecules of air or ether—are alternately raised or lowered, without any longitudinal change. It can be easily observed that a light object floating on the surface of the sea does not change its place. This being established, a simple oscillatory float at the end of a lever can be easily placed. The shaft connected with the lever will thus receive a rotatory motion.

This idea, which had been previously brought forward by M. Roche, of Nuires, who, in fact, made some experiments in the matter on the Mediterranean, has been taken up on a more general line by M. Gauchez, in the apparatus, shown in cuts 1 and 2, by employing compressed air which is stored up in reservoirs, and afterwards supplied on demand. This arrangement has the advantage of storing up force and forestalling stoppages, and it would appear, moreover, that ordinary mechanical transmitting agents would soon be destroyed by the violence of the shocks.

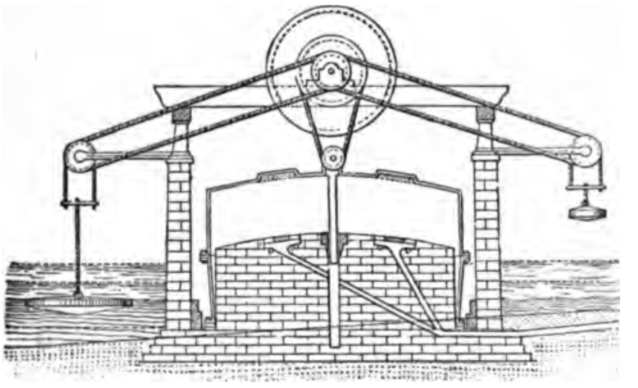


FIG. 1.

The apparatus is composed of a submerged float weighing from 110,000 to 220,000 pounds, according to dimensions, and of a compressor iron bell, which is connected with the float by ropes wound round pulleys, as shown in cut 1, and of air reservoirs which have a pressure as high as 55 pounds. These are set up on the shore at a certain distance and connected with the compressor by special conduits (Fig. 2). The float, falls or rises with the waves, and in its downward movement it raises the bell by means of two ropes that are wound in contrary directions on the pulleys. In this movement, the bell draws in the air through the openings placed in the upper part, and when the ropes slacken, while the float rises, it falls back by its own weight and drives the exhaust air into the reservoirs. Another weight keeps the chains always at a suitable tension. The bell is closed in the lower part by an india rubber membrane which is fastened to the masonry.

FIG. 2.

The length of the chains is limited, so as only to keep up with the tide, from the half wave in a low tide to the half wave of a high tide—presuming that the greatest is not over sixteen feet. By this means the slightest swells are utilized, and the troubles that would be occasioned by abnormally high tides, are avoided.

The great difficulty presented, by this arrangement—so simple in other respects—would be to prevent an undue heating of the air, and especially to provide it a rapid flow into the reservoirs. The waves following one another every nine or ten seconds, on an average, it would be necessary to fill and completely empty the bell in that time. The originator of the system believes that the bell should have a diameter of about eighty feet, with a total height of 23 feet, and with all its appendages would weigh some 132,000 pounds. The run could be limited to some 6 feet 6 in., so as only to aspirate a volume of air of from 800 to 900 cubic metres. It would be necessary to reduce the dimensions of the orifices, in order to limit the air-holes, and to furnish the bell besides with powerful safety valves, so as to insure the passage of a portion of the air into the atmosphere, when the pressure in the reservoir would prevent the introduction of the entire volume.

We will say no more on the difficulties of execution, as a question of this nature cannot be decided by a simple calculation, and the model, which is on the scale of one-tenth, can only give an approximative idea of what the apparatus would really do. Still, there are grounds for believing that there is nothing insurmountable in these difficulties, especially in view of those successfully overcome in the great works of Mount Cenis and Saint Gothard, where compressed air was employed at equally high pressure, and probably we shall soon see the first application of the most powerful, and the most redoubtable perhaps, of natural forces in the service of industry, by means of an improved apparatus of M. Gauchez.

IMPROVEMENTS IN SECONDARY BATTERIES.

A FOREIGN journal says: "At a time when secondary batteries are beginning to find their proper level, even in the commercial world, students of this branch of electricity will read with interest, accounts of any real improvements which have been made in them.

So long ago as the year 1863, Mr. Fitzgerald described the effect of red lead in batteries, and suggested its use; but little was done with it until lately, when the Faure accumulator was introduced. Mr. Tribe, who has been engaged on a series of elaborate experiments with secondary batteries, has taken out a patent, in which he claims the employment of a negative plate, composed of, or consisting of, peroxide of lead, substantially as described.

In carrying out the invention, he employs a negative plate, consisting of peroxide of lead in a solidified of compressed condition, or in any other convenient form, the same being contained in a perforated or porous vessel or receptacle, not being a conductor, nor easily acted upon electrically; or the peroxide of lead may be either employed direct in the condition before mentioned; or precipitated peroxide of lead may be deposited upon the surface of the peroxide of lead. This invention may be carried into effect in the following manner:

A rectangular frame may be employed, having three sides of prepared wood, slate, porcelain, or any non-conducting substance not easily acted upon by dilute sulphuric acid. The fourth side is completed by the employment of a suitable conductor projecting out of the liquid, and insulated on those parts which are in the liquid, and not in contact with the peroxide of lead. Into, or upon this, or some equivalent form of frame, he places peroxide of lead, which, if, for example, in the form of powder, may be placed into or upon the retaining frame, and subjected to pressure. The peroxide of lead may be employed in a dry or in a moistened condition, either with water or with dilute sulphuric acid. Or one or other of the non-conducting lead compounds—such, for example, as the monoxide of lead, or the sulphate of lead—may be mixed with peroxide of lead, and be subjected to pressure in the retaining frame, and then be converted into peroxide of lead by electrolytic action; or a core of compressed peroxide of lead may be fitted into the centre of the retaining frame, and covered with some suitable lead compound, which may then be converted into peroxide of lead by electrolytic action. The negative element, when prepared, may be sheathed or inclosed in artificial or vegetable parchment, felt, porous earthenware, or other equivalent materials.

When the negative plates, composed of peroxide of lead, are employed in secondary batteries, the positive plates employed therewith, may be of any suitable element, and the exciting liquids or electrolytes may be similar to those now employed in secondary batteries.

Mr. W. B. Brain, of Cinderford, patents a method of constructing secondary batteries of a thin strip of lead, folded up with a band of porous material, coated on both sides with red lead. The porous material may be asbestos, felt, spongy india-rubber, flannel, etc. The lead is poured into chambers, bags, or closed envelopes, which hold the oxydizing and deoxydizing agent, and holes are punched through from each side roughly, the burred edge and the bulging on the punched side serving to keep the red lead within the envelope, and in metallic contact with the lead walls, which are thus rendered more rigid.

A greater departure has been made by M. de Lalande, who, in conjunction with M. G. Chaperon, of the Mines d'Alonso, Spain, has patented a new battery in which oxide of copper is the depolarizing agent. The negative element is formed of a rod of gas carbon in a porous cell, packed with pieces of carbons, the interstices being filled with oxide of copper. The positive element is of zinc, in a solution of caustic soda or potash. This arrangement is intended for use as a primary battery, but it may be employed as a secondary. Mr. Brush, of Cleveland, Ohio, has obtained an American patent for a secondary battery, in which the plates are formed with receptacles for the oxide of lead, which is compressed after filling.

From these selections, it will be understood that recent improvements follow rather the endeavor to hit upon the best shape to work up the lead and its peroxide into convenient forms, than to discover other combinations more efficient and less troublesome, if more costly, than the received designs. Meantime, it is worthy of note, that in several cases the simple Planté is preferred.

*DETECTION BY ELECTRICITY OF THE ANNUAL CULMINATIONS OF THE SOLAR INFLUENCE ON ORGANISMS.**

BY NILS KOLKIN.

IT came to my notice, several years ago, that if one end of a hair or thread were tied to a watch key, or some similar object, and a person, seated comfortably before a table, with his elbow resting on the same, took hold of the other end, so as to raise the key from the table and keep it suspended, it was impossible to keep it still, in spite of all precautions. Oscillations would begin which, if the hands were warm, would attain great violence. If the key were permitted to strike against anything except glass, silk, dry rusty iron, or other bad conductors of electricity, the oscillations would be interrupted by short pauses occurring at regular intervals; and the strokes between these pauses would correspond with the age of the hair, or, more correctly, their number would show how many years old the person was when he lost it. I understood that these oscillations were caused by electricity; that the key was positively or negatively charged and repelled by the arm and hand, which were similarly charged.

I have since investigated this phenomenon, as much as my time has allowed, and I shall here carefully give the results of my experiments. I have also substituted electricity from other sources than that used in those primitive experiments, and when I have not met the same success it is due to the fact that I am not a practical electrician.

There is no known principle that accounts for the pauses in the oscillations. But the explanation seems to be that—When any organic substance is continually charged by positive or negative electricity, and discharged in rapid succession, under certain circumstances, the substance itself, and things in contact with it, will, after a certain number of discharges, for a moment become non-conductors; and the number of those discharges will correspond to the age of the vegetable or animal from which the substance is derived. I say "under certain circumstances," for I do not know whether repulsion and attraction is necessary or not. My experiments have always been with a suspended key, except with a metallic spring, placed horizontally, which is virtually the same thing. The resistance to electricity during the pause is, indeed, very slight; it does not take a very powerful charge to overcome it. The weaker the supply of electricity the better it is. Shortening the fibre by which the key is suspended will give the best results. It will make the oscillations more rapid, and they ought to be rapid enough to make it necessary to count them by twos, for the pause will thus be better noticed.

All organic substances possess this age-telling property, except absolute non-conductors, as silk. If substances of different ages are used together the age of the oldest only is shown. This fact makes it possible to find the age of substances of all forms, even with a suspended key. A fibre of an annual plant may be used, and any dry substance tied in it: in case of liquids, the fibre may be saturated with them. Liquids are good conductors, and must be guarded against. The smallest particle of juice, or sweat, or anything, when of higher age, will show its presence.

The age of a substance here must not be taken to mean the time it has existed as such, but that age which the vegetable or animal that may be its source had when its connection with that source was severed. A leaf may be two months old, but it shows the age of the tree; a drop of milk, that of the cow. I have permitted myself to call this "organic age;" but as we have nothing to do with any other kind here the word "age" must always be taken in this sense. Any part of an organism—any seed, fruit, secretion, or any part of product whatever—has the same organic age as its source. The age of vegetables counts from the time they sprang from seed. Those propagated from roots or cuttings have the age as the original. A potato showed between 800 and 900 years. The age of animals corresponds with what is commonly termed so; but new-born young have the same organic age as the mother.

This age-telling property of organisms does not seem to be destroyed by time. To what extent chemical change does it I cannot say. Considerably decayed wood retains it. Some kerosene, which caused the discovery of the age-telling property of liquids, showed constantly eight years; but this might have been due to some foreign substance.

It is, of course, plain to all that the interruption of the oscillations has nothing to do with our civil year as it is divided off in the almanac, but with a natural year. A natural year in our zone consists of an increase, a culmination, and a decrease of the solar influence. It is the number of those annual culminations to which an organism has been exposed during life that is shown. In case of annual plants, grown during the increase or decrease, they will show a year though they have not been exposed to the maximum influence of the sun. So with animals less than a year old. The oscillations generally cease very abruptly, but when a considerable fraction of a year remains uncounted there is often a gradual subsidence into a pause. How it is with organisms under the equator, where the sun passes twice a year, I do not know. But a knowledge of it would throw some light on this question.

That the sun has great influence on plants all know; but that it should have so great an influence on animals that each annual increase, culmination, and decrease of that influence should be registered in their organisms will seem to many a great heresy. The sun, however, has more power than is generally supposed. Many persons will know that they do not feel the same under its decrease and increase. They do not seem to be the same persons in the autumn and in the spring, everything else being equal. The influence of the sun prevades all Nature, and reaches life, both animal and vegetable, in recesses completely hidden from its rays.

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* Read at the Montreal Meeting of the American Association for the Advancement of Science.

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THE ELECTRIC LIGHTING OF MILLS.

AFTER serving for a generation in the laboratory and the class-room for instruction in the laws of physics, the electric light was devoted to the spectacular purposes of extraordinary forms of advertising. The only and original circus, the opposition line of excursion steamers, and the store of wondrous bargains, were wont to use the electric light as a link in their logical chain to prove their claims upon public patronage.

Now that it is well past the experimental stage, electric lighting is recognized for its merits, and becoming one of the necessities of civilization.

At the recent meeting of the New England Cotton Manufacturers Association, much of the time was devoted to the consideration of the value of electricity in its applications for lighting textile mills.

This organization is composed of owners, treasurers, agents and superintendents of cotton mills, and other allied industries, and hold meetings semi-annually for the purpose of considering matters of importance in their work. These sessions are especially practical in their nature; everything being appraised according to the value of its application. That the governing board of such a society should choose electric lighting as one of the subjects for the session, shows the extent to which its importance is recognized.

None of the papers were electrical, but all showed an accurate knowledge of the applications of electricity. Instead of the units fixed by the Electrical Congress, dollars and cents were the standards referred to; and due consideration was given to what one speaker termed "the more valuable collateral advantages of the electric light."

Space will not permit a full resumé of the proceedings and detailed reports of the transactions have already been given in our textile and mechanical contemporaries. * but the remarks of the different speakers were of so much interest, that we cannot refrain from giving brief extracts of them:

Mr. Kilburn, a manufacturer of New Bedford, regarded the light as a very desirable one, and said, "that his folks were anxious to get it into their mills."

Mr. Lippitt, of the Globe Yarn Mills, of Woonsocket, said, that from careful estimates, there was a saving of expense in the use of the electric light in his mills, and thought it was the general expression that the electric light was superior to almost any other known; that it was fully as safe, if not safer, than any other method of illumination; that a late fire had caused the loss of thousands of dollars by the burning off of the gas pipe; and the dangers of electric lighting could be better guarded against, than the dangers connected with any other method of lighting that he knew of."

Col. Livermore, of the Amoskeag Manufacturing Company, of Manchester, N. H., gave some statistics as to expense, which he had collected in the use of the arc light in his mills, and said: "Our experience is, that where a great deal of gas is used in a room, people hold off as long as they can, because of the heat it produces, and its vitiating effects upon the air But they have no such scruples with the electric light, and unless people are more watchful than I have been able to be, they will find that the electric light is run more than gas would be. The saving, perhaps, will not appear in the balance sheet, but I confidently believe will appear in the quality and quantity of the work."

Mr. Ludlam, of the Merrimack Manufacturing Co., in referring to the cost of electric lighting as compared with gas, said: "If anything, the gas has a little the best of it. The *collateral advantages, however are very great.* Among these advantages are the improved quality of the atmosphere, the absence of heat, and, I think, a decided safety from fire.

As Mr. Woodbury has pointed out, electricity is like many other agencies we employ about our mills—if we do not take care of it, it will do mischief. So will steam, especially when used at a very high pressure, so will oil of vitriol and muriatic acid, which we use about the print works. I don't think, with an electric plant properly put in, that there is very much reason for apprehension on the score of danger. The first plant that was put into my mill was put in with uninsulated wires, before the underwriters had tabooed that sort of thing, and we ran it for a year or more with perfect success, and it is running there to-day."

Mr. Chas. L. Lovering, of Taunton, pronounced the electric light perfect, and said: "I did think, up to a year ago, that there was nothing to be saved in the way of expense, interest, etc., but I am rather of the opinion now that there is a saving over gas."

Mr. Edward Atkinson, President of the Boston Manufacturer's Mutual Fire Insurance Company, in speaking of the dangers of the light, said: "that their conclusions, after having delegated Mr. Woodbury to investigate the subject, to which he has devoted his whole time, has been, that the electric light of either sort is *safer than gas or oil*, but that the choice of the underwriters would be for the incandescent system rather than for the arc light system. After referring to the mechanism of different lights, he concluded his remarks by saying: "Under what has been called the *electro mania*, various substantial corporations, and many wildcat companies, have been organized. The latter have been floated at fancy prices for the stock, or at least the attempt has been made If it were within the province of an underwriter to issue policies of insurance upon the profits which are expected, to be based upon the share of patent rights in electric lighting, held by some of these companies, I think that it would be quite safe to issue policies of a kind once offered to me when I was clerk of a manufacturing company, upon a cotton mill, which I submitted to one of the oldest stock underwriters in State Street for insurance. I submitted the plans to him and described the risk; and he cheered me by saying that he would issue a policy at a *very low rate of premium*. As the mutuals had just begun at that time, and as the stock rates were very high, I was much encouraged by this remark, and as I was preparing to draw my application, he said: 'Perhaps you misunderstood me, Mr. Atkinson; the low rate will be to give you a policy assuring you that the mill will be *consumed by fire* within a reasonable time. We cannot insure you against loss by fire at any price.' I think it would be pretty safe to issue policies assuring a large proportion of those who take stock in patent rights upon electric lighting, that they will make no profit out of them. The contest wil be bitter; but the end is not far off when the manufacture of electric apparatus and the use of the electric light will come down to a commercia basis, with a fair commercial profit to the best companies making the apparatus, and a fair commercial profit to those who apply this apparatu to use.

My conclusion, individually, is this, that the incandescent lamp is th

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* (*Cotton, Wool and Iron* (Boston), Nov. 4 and 11, have a stenographic report of the meeting.)

> true factory light of the future; that it is the safest light which can be put into a mill; the best light to assure perfect work; and the best means of lighting a mill, if regard be given to the health of the operatives. As a mere matter of economy and profit, I have been assured by skilful men who have made use of the electric light in their own factories, that even if it should cost much more than gas they would not give it up, because under its use they can secure more and better work from their machinery, owing to the more vigorous condition and vitality of the operatives who attend it.
>
> While I say that I consider the incandescent system the safest, we do not object to the use of the arc lamp under proper safeguards. I consider either better and safer than gas or oil, if put up properly and operated under constant supervision. It is not to be inferred that there is no danger of fire from the incandescent light. This force cannot be applied without danger; but all these dangers, as Mr. Woodbury has stated, are of a sort easily avoided; and the dangers from the incandescent system are more surely avoided than the dangers from the arc system of lighting.

In reply to a question as to whether the proportion of fires in mills lighted by electricity were not in excess of all the other fires in the same mills, Mr. Atkinson said:

> The number of fires in electric plants in mills under our supervision is greater than from any single cause that has ever come under our notice in the same time. And at the same time they have led us to the conviction that they are relatively a safe kind of fire, and we have had no fire from an incandescent light, although some have occurred elsewhere. These fires have occurred under such conditions that they have all been put out without loss. There have not been many fires from the use of gas, but there has been very heavy losses from the escape of gas.

The first and most important paper read at this meeting, to which very complimentary allusion was made by most of the speakers, and to which we would direct especial attention, was by Mr. C. J. H. Woodbury, Agent for the Boston Underwriters. Mr. Woodbury, after speaking at some length upon the principles involved, the character of the light, and numerous details of expense, also the efficiency of dynamo machines and storage batteries, took up the question of the safeguards of electric lighting.

This is, we believe, the first time that anything has appeared from a responsible source upon the measure of the fire hazard due to electric lighting.

The whole principle involved in the elements of danger with strong electric currents was given in the following language:

> It is sometimes assumed, by those ignorant of the facts, that electric lighting apparatus cannot set a fire. Electricity is no exception to other forms of energy. All power can be converted into heat. Your mills are equally liable to hot bearings, whether the motive power is derived from the fires under the boilers, or to the head of water in the mill pond. Whenever any one states, as a principle, that the electricity used for lighting *cannot* set fire to anything, he is not only in error, but is uttering a fallacy which will lead to the destruction of property, if carried into effect in any electric lighting system.

As a matter of assistance, in considering the question, the following record of twenty-two fires, caused by electric lighting, was given as occuring in sixty-one mills, between the autumn of 1881 and May 1882, and assignable to the following causes:

> Eight were from globules of melted copper, or particles of hot carbon falling out from the bottom of the globes. The actual number of fires from this cause was probably many times this number. That class of fires will not continue to happen, as all makers now set their lamp globes in a tight stand with a ridge around the edge. A flat plate will not answer the purpose, as there was one instance where drops of melted copper rolled off and set a fire. Four fires were due to leaking water, or washing floors; and two more were caused by water, in a dye house, condensing on the building to which uninsulated wires were fastened. In most of these instances, a grounded circuit formed one of the two connections necessary to divert the electricity from the wires. Many of the lower carbons fell from lamps; and five fires were caused where they fell upon combustible material. Three fires were caused by cross arcs from one wire to another, where uninsulated wires were fastened against conductors. In one instance, the conductor was formed by dust settling upon uninsulated wires; and on a damp day it absorbed enough moisture to form a path for the formation of a cross arc, which started a slight fire. In another instance, the wire was fastened to a damp beam which was decayed, and was burned nearly in two by the smouldering fire. And in the third instance, damp brickwork, in a tunnel, was a sufficient conductor to establish an arc, which did not do any material damage there, but injured the dynamo. Other fires, produced by cross arcs, started by water, forming a connection between two wires, have been referred to.
>
> In my connection with electric lighting matters, for the Underwriters' Union, I know of two fires, caused by improper switches: two by water, reaching the wires of a circuit already grounded, and one from wires coming in contact with a building, so that their insulation was worn away.

To a superficial observer, this appears against the safety of electric lighting apparatus, but the conclusions of the speaker, whom, we presume, investigated each instance, were of a contrary nature, as he considered that everyone of these fires, in the light of present experience, could have been avoided, by anticipating their possibility, by the use of well known precautionary measures, which are summarized, as follows:

> Electricity forms the safest method of illumination, when the following precautions are observed: The system insulated throughout, so that there is no electrical communication with the earth, or from one part of the apparatus to another, except through the proper conductors, even if the wires should be exposed to water. All switches made with a lapping connection, so that no arc can be formed. Arc lamps provided with globes closed underneath, and the frame so arranged that the lower carbon could not fall out, even if the clamp failed to hold it securely. The wires of incandescent systems, provided with a sufficient number of fusible links, to secure the system against any damage from an excess of current.
>
> The carrying out of these principles, in every detail, requires careful work and constant watchfulness.

The importance of regular tests, to detect any "escapes," is urged very strongly, because there is no assurance that an electric lighting system will remain clear of all conductors, even if satisfactory when first installed.

The extreme instance of danger from ground connections, is stated to be, that

> When electric lights become dim in rainy weather, it is conclusive evidence of ground connections, which divert the electricity from the system, causing both commercial loss of electricity and great danger of fire. Two contacts are necessary to divert electricity from an electric lighting system. If one contact already exists and connects it with the earth, only one more contact is necessary to conduct a portion of the electricity from the system.
>
> In such an event, if the electricity overcomes a conductor, of sufficiently high resistance, the electricity is converted into heat, sufficient to burn any combustible substance, which is present.

The regulations which Mr. Woodbury prepared for the Underwriters' Union, are given, and the paper concludes with the remarks:

> Electric lighting should be encouraged, on account of its inherent qualities of safety. Any system that is in conformity to the insurance regulations is also in its best condition electrically.
>
> Electricity, like all forms of energy, is dangerous to the extent that it is not held in control. The same is true of steam in boilers, or water in mill ponds. Like fire, they are all "good servants, but poor masters."

But few have had such advantages of observing the application and use of the electric light in such a large number of different establishments, and also the opportunity of special investigation in this work; and Mr. Woodbury's paper is a welcome contribution to the subject, both for the information which it contains, and the conclusions, based upon a wide field of experience.

STORAGE BATTERIES.

THE recent exhibition of the Brush secondary battery, in this city, has again attracted public attention to the general subject of the so-called storage of electricity. The information given in regard to the construction of this battery, is of the most general character, and is entirely insufficient to enable us to form any intelligent opinion with respect to its novelty or efficiency, or, as to its chances of commercial success.

It is stated by Mr. Brush, and by those who have charge of the exhibition here, that the battery consists of lead plates, and the ordinary solution of acidulated water, and that the plates are prepared by some secret chemical process, by which greatly improved results are obtained. Very high efficiency is claimed for it in a general way, and those who are interested in it, appear to be confident that it will prove economical and reliable in use. It is to be observed, however, that similar claims were made in regard to the Faure battery and others, which have been before the public for some time, and so far as we are able to judge, from the best information accessible to us, none of these batteries have yet proved available for ordinary use, and it appears to be the better opinion that the storage system will have a much more restricted field than its advocates claim for it.

Such tests of the Faure battery, as we have seen reported, seem to indicate that a higher efficiency than 50 per cent. cannot be safely relied upon in practice. That is, only about one-half of the current expended in charging the battery can be recovered in useful work, and even this efficiency would probably be considerably impaired, unless the battery were used within a comparatively short time after charging it. Aside from the loss of current, the expense of the battery appears to be quite a serious item. Taking, for instance, the plant at the *Théâtre des Variétés*, at Paris, it is stated that 265 Swan lamps are used, and are supplied by about a hundred Faure batteries. The total weight of the batteries is stated to be fourteen tons, ten tons of which is active material.

No doubt, in certain exceptional cases, such batteries will prove extremely useful, but for general use in a system of distribution from central stations, we think, the advantages have been largely over-estimated. It is true that the conductors for distributing the current may be considerably reduced in size, but the cost of constructing and maintaining the secondary batteries, would, in a large measure, make up for this advantage, if not entirely counterbalance it. The advantages claimed by way of reducing the capacity of engines and dynamos, has also been considerably overrated. Experience seems to show that no machinery can be relied on for constant use, working anything like 24 hours a day. Considerable time must be allowed for making necessary repairs and overhauling machinery, and very reputable mechanical engineers have expressed the opinion that no practical advantage could be gained by running engines and machines more than twelve hours per day, as the increased wear and tear, and the liability of accident would counterbalance the saving in the cost of the plant.

It is obvious, also, that the introduction of the storage battery largely increases the complication of the system.

No doubt there would be considerable demand for a really efficient secondary battery for use in places where expense is not a controlling consideration, but we by no means share the sanguine views of those who believe that such a battery would effect a revolution in present methods of lighting.

—— "THIS 'LECTRIC FLUID must be a dangerous substance," said a country visitor, "see how yellow it turns the gas!"

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from page 280.*)

THE wire, electro-magnets, and escape wheels, just described, are used to operate the letter type wheels of the instrument. Each instrument contains another type wheel, on an independent shaft, having all of the figures and fractions necessary to be used, engraved on its periphery. This figure type wheel is operated by a separate figure wire, magnet, escapement anchor, and escape wheel, in a manner precisely similar to the letter type wheel, already described. The two type wheels revolve in planes about ⅛ inch apart, but over the same printing pad, and over the opposite margins of the same moving band of paper, which is ¾ inch wide. The figure type wheel is revolved in the same manner as the letter type wheel; *i. e.*, by pulsations produced in the relay local circuit by the revolving cylinder of the transmitter, repeated into the main circuit and reproduced on the anchor and escape wheel of the printing instrument. An inking wheel, consisting of discs of felt soaked in printing ink, and held together by ebonite flanges, revolves over each type wheel, and serves to keep the type sufficiently inked.

It now remains to show how the printing of a letter, or character, is effected.

Whenever the revolving cylinder of the transmitter, normally in motion, is stopped by the depression of a key, the vibrating-arm falls into one of the notches in the 30-toothed wheel and closes a local circuit consisting of all the printing relays of all the main circuits. A branch of the main battery for each circuit, is connected to the armature lever of each printing relay, while the main lines are connected to the lower contact points of the relays. When the two platina points are brought into contact, a current flows over the main line, actuating a separate electro-magnet, printing press, and feeding mechanism, in each instrument. It will thus be seen that each instrument consists of three integral parts, operated by three different line wires, although assembled on the same base and within the same frame. The printing mechanism consists of an armature lever constructed so as to raise an india-rubber pad, bearing the moving band of paper, against both type wheels, whenever the circuit is closed on the printing wire. The pad revolves on its own axis so as to present fresh surfaces to the type wheel with every impact. When the paper is pressed against the type wheels it receives an impression from the letter or figure on the wheel which was moved last. The other and idle wheel presents the unison dot to the paper, and the printed slip therefore presents a record of letters on the upper margin, and dots on the lower; or, dots on the upper margin and figures on the lower. The letters are always printed in one line, occupying the upper margin of the strip of paper, and the figures are always printed in a line on the lower margin of the paper, with dots opposite to each letter or figure printed. The reason for the appearance of the dots is this: the paper must strike both type wheels when it is raised, and the operator working the transmitter always takes care to rotate the type wheel used last to the unison dot, before rotating the other wheel; the downward movement of the printing press lever operates a feeding mechanism, so as to push the paper out from the machine and leave sufficient blank paper under the type wheel for the impression of another letter. The feeding mechanism is constructed as follows: an arm, independently pivoted, carries a revolving ebonite disc, which is held down firmly on the paper after it leaves the printing pad, by a spiral spring attached to the pivoted arm. This disc presses the paper upon a toothed wheel, the teeth of which cut into the paper, so that when the toothed wheel revolves the paper moves with it, in the direction of its revolution. The toothed wheel is on the same shaft with a fine toothed ratchet wheel, which is moved by a dog engaging in its teeth, on the downward movement of the printing lever. A pin, projecting from the side of the printing lever, works in a slot in the dog and communicates the motion from the lever to the toothed wheel. Another stationary dog, falling into the notches between the teeth of the wheel, prevents any backward motion of the feed apparatus, so that the paper cannot be dragged backward when the printing lever moves upward. The same main battery operates all three wires of the same circuit, consequently, the current is sometimes closed on two of the wires of a circuit at the same time. For instance, when the instruments are idle and ready to receive a message let us suppose that the first letter of the message to be printed is *a*. This is the second letter in the alphabet, as the (unison) dot comes first. The first wave of electricity passing over the letter wire, will cause all the letter magnets to attract their armatures, the escapement anchors to be moved downward once, and held there, and the escape and type wheels to be moved forward one tooth and one letter respectively. They must be held in this position by a prolongation of the current on the letter wire, as the act of releasing them will cause the escape and type wheels to be moved forward one tooth by the action of the retractile spring. Now, if at the moment the current is put on the letter wire, and the letter *a* brought opposite the paper, the cylinder of the transmitter be detained, the printing circuits will be closed, and the main batteries will all be split between the letter and printing wires, half of the current passing over each wire. This action takes place whenever a letter or figure, which requires a *downward* movement of the escapement anchor, is printed.

The portion of the instrument next requiring description is the automatic unison device, which operates entirely independent of the will of the operator who is transmitting the quotations. It will be remembered that each type wheel is worked by a separate wire, and revolves on an independent shaft; one of the type wheels carries, between its spokes, and on the side next to the other type wheel, a pivoted arm, normally held downward towards the hub of the wheel by a spiral spring. A boss, rigidly fixed to the frame of the machine, raises this arm up about ⅛ of an inch; when in the revolution of the wheel, the arm comes opposite the boss. The object of the boss is to prevent the arm from falling into a slot, which is carried by the other type wheel, which slot is normally opposite the arm and ready to receive it at the same moment that the arm is lifted up by the boss. Whenever one of the wheels is out of unison, that is to say, does not rest with its dot opposite to the paper while the other wheel is revolving, the result follows, that the unison arm falls into the slot, and the two wheels are thereby locked together, arm-in-arm as it were, and revolve together until the dots on both get opposite the paper, when the arm is lifted out of the slot, and the idle wheel is left stationary while the other revolves alone. It will be observed that this operation will take place equally well when either wheel is "thrown out" of unison; because, in one case, the slot moves under the arm and allows the latter to fall in; while, in the other, the arm moves over the slot and falls in. In order to facilitate the operation of this unison, the retracting spring, which produces the upward movement of the escapement levers, is one single flat steel spring pressing equally upon both escapement armatures, and in the same direction. The result is, that the wheel which is "setting" the "thrown out" wheel does not have to operate against the retracting spring of the latter, as there is but one spring, and that is pressed away from both armatures by the armature which is working. A delicate spiral spring sustains the weight of each escapement anchor, lever, and armature, so that the escapement lever of the idle wire does not fall into the notches of its escape wheel when the retracting spring is withdrawn by the working of the other wire. An additional essential part of the unison apparatus consists of an arm projecting from the side of each escapement anchor, and another arm projecting from the side of each escapement wheel shaft. When the wheel which was "thrown out" has been rotated to its proper position, the arm on the anchor catches against the arm on the escape wheel shaft, and holds the latter fixed, and it cannot be moved until the first downward movement of its own anchor releases the arm on the escape wheel shaft from the arm on the anchor. This unison operates automatically only when required, and either wheel sets the other interchangeably. The instruments, above described, have 5 ohms resistance in each magnet; and are worked in circuits containing as many as 30 instruments, and up to a maximum of about 6 miles in length. An average of 3½ cells of carbon battery, per instrument, is required; and the type wheels are rotated at the rate of 55 revolutions per minute, requiring 13.75 emissions of current per second, producing an average speed of 14 English words per minute.

In order to prevent the destructive effects of the large spark, normally produced at the relay points, condensers are used on all of the type (letter and figure) relay points. One armature of the condenser, consisting of 100 sheets of tin foil 10½in.x16½in., is connected to the main line where it leaves the relay points, while the other armature, of 100 sheets, is connected directly to the earth. The charge received by the condenser is about equal to the magneto-electric current developed in the line on the withdrawal of the battery current, by the discharge of the electro-magnets, and the two neutralize one another before the latter reaches the relay points to cause any spark there. There are 1,000 of these instruments now working, in New York City and Brooklyn, from one transmitter.

(To be continued.)

IT is not only the inventors of the world that have now turned their thoughts to electricity, but also the speculators. The progress of the practical science to that degree of industrial perfection, which will render it a paying investment from a financial point, is necessarily slow. Some companies have indeed established themselves almost at once as profitable undertakings; but the formation of large money enterprises, on the strength of inventions which are not sufficiently tested, is certain to result in disappointment. The quotations of some of the minor English companies have greatly depreciated. In fact, electricity, though a giant, is yet young and should not be made a favorite object of speculation. We are in favor of the widest freedom, so far as manufacturing enterprise is concerned, for here there is a solid basis, but the abuse of electric discoveries in England by the "promoters of the undertakings" has already thrown some discredit on solid companies. The shares of some of the branch companies that were formed have declined considerably, others have been obliged to wind up.

But whatever stock jobbing misfortunes may be reported, we have no doubt that when electricity comes to be more adapted to all industries, as it will be before long, it will then offer a large and safe field of investment.

—— MR. N. STEVENSON, of London, uses a small Swan incandescent lamp to illuminate the cavity of the mouth in dental operations. It is fitted into a vulcanite cup which acts as a prop to keep the jaws apart.

NEW INSULATED WIRE.

AMONG the many inventions, in telegraphic and electrical apparatus, which have been brought out during the last three or four years, perhaps, none has received so much attention, as that which is intended to serve as a cheap substitute for the high priced gutta percha and rubber covered wires.

Inventors, in both Europe and America, have given much of their time and attention in seeking to produce a cheap compound, which shall embody, as nearly as possible, the good features of the above expensive wires; but many have failed in the attempt. The conditions required in a substitute, especially for ærial purposes, are: 1st, cheapness; 2d, insulation; 3d, imperviousness to moisture, or ability to resist atmospheric influences. We learn from parties, who have made a careful study of this subject, that to produce a compound complying with the above conditions, is no easy matter, especially when the question of non-inflammability is also considered, so as to include a wire suitable for electric lighting. In fact, it is found that improvements in this direction are not an exception to the general law governing similar cases; for, as the excellence of the compound is increased, whether in the matter of insuring better insulation, or ability to resist atmospheric attack, the cost is increased in the same ratio.

There are two or three new forms of insulated wires, which have come into prominence of late, on account of the large quantities which have been put up during the past two or more years; and, judging from their steady increase on poles and housetops, we are inclined to think that "they have come to stay." The first of these is the "paint wire," now seen wherever an electric light makes its appearance. This cannot be classed as a new invention, as covering of the same nature has been used for several years.

It is, however, acceptable to the Board of Fire Underwriters, on account of its non-imflammability, and is probably as cheap a covering of its kind as can be obtained. Large quantities have been put up all over the country, and its use will, no doubt, continue to be quite extensive, until a better wire is found. It is now manufactured by Holmes, Booth & Haydens' Ansonia Brass and Copper Company, and others. Another insulating covering, which has become prominent of late on account of its extended use, is the "K. K." wire, so called after its inventors, Messrs. Knudson & Kane, of this city. This wire has stood the test of atmospheric influences for two years, and so far seems to answer the general demand for a cheap and durable insulator.

The compound consists of refined mineral asphalt, combined with various oils and other ingredients, which give to it flexibility, non-volatile qualities, etc. Its water-proof qualities are far superior to either the paint or paraffine wires, and its durability in the atmosphere promises for it an important future. The iron "K. K." is extensively used by telephone, fire alarm, police, and district telegraph companies.

This branch of electrical science being one of great importance, we shall endeavor to keep our readers informed from time to time of new discoveries of value, which may make their appearance.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

VII—STATO-ELECTRICAL STORAGE.

AS the electrical machine developed, experimenters with electricity were encouraged in all directions. They most persistently endeavored to concentrate the wonderful substance and preserve it for later use, but their efforts so often resulted in novel modifications of the prime conductor only, that at last a new announcement of its successful storage was confidently expected to eventuate in a different version of the same old story.

In 1746,[1] however, a sensation, pervading all society, was created by the news that in the village of Leyden, in South Holland, the long sought object had been attained, and the mysterious fire collected in a bottle; which, from the place of its discovery, was first called the "Leyden Phial," and is now familiarly known as the "Leyden Jar."

A story so trite, that its several versions[2] are familiar remembrances of one's school days, needs no lengthy repetition. From a contemporary account,[3] in brief, it appears that Prof. Muschenbrock, and associates, suspecting the atmospherere of conveying away the electricity which electrified bodies so speedily lost, enclosed some water to be electrified, in a glass bottle, in the hope that thus protected from the air, it might be given and enabled to retain a stronger charge for a longer time.

At first they perceived no result, but on a fortunate occasion, the operator holding the bottle in one hand attempted with the other to disengage from the prime conductor of his electrical machine, the wire by which the water in it had been electrified, and he instantly experienced the convulsive shock which has since been, and is now, so often suffered from motives of curiosity, amusement, or anticipated physiological benefit. From a publication of the year 1747, an illustration of this celebrated event is reproduced in Fig. 23.

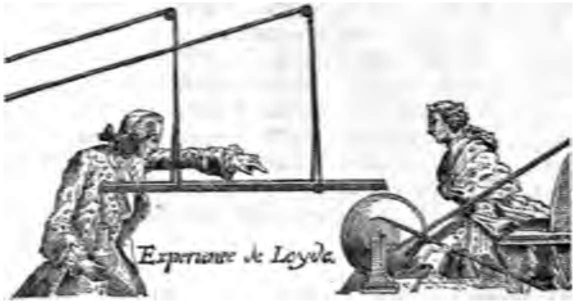

Fig. 23.

Muschenbrock wrote to Reaumer a famous letter giving an account of the first shock he received, in which he says that it was two days before he recovered from the blow and terror, and that he would not take a second shock for the whole kingdom of France. Little as we now think of a shock from even a powerful Leyden jar, he was not singular in his estimate of this disagreeable sensation, for Winckler, Allamand, and many others, who immediately subjected themselves to this surprising behavior of the "accumulated electric fire," generally by removing the jar and dipping the finger in the electrified water, considered themselves as similarly affected.

The first emotions of astonishment at such a "prodigy of nature and philosophy" having abated, it was thoroughly investigated. Mr. Watson found that the shock could be transmitted through several persons, and that its force was greater, the thinner the glass of which the jar was made; that it was independent of the power of the machine used to electrify the water, and dependent directly on the extent of external surface of the jar covered by the hand. Dr. Bevis thereupon suspected that the hand acted merely as a conductor, and successfully substituted for it a coating of tin foil, thus giving to the Leyden phial, externally, the appearance it still preserves. Soon afterward, conjecturing that the function of the water in its interior was similar, and thinking that metal should be more effectual, he filled three phials with shot instead of water, and obtained a shock which seemed of remarkable intensity. His Leyden phial, thus derived, and called the Bevis jar, is still popular, but is usually filled with crumpled metal foil instead of shot as shown in Fig. 24. His combination of phials is now called a Leyden battery, and in its modern form is shown in Fig. 25.

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[1] Lardner. Cab. Encyc. London, 1841. p. 18.

[2] See Muschenbrock Elem. Phys., 1748. Nollet Essai, etc. Paris, 1747. Priestly Hist. of Elec. London, 1775. Lardner. Loc. Cit. Du Moncel Hist. of Elec.

[3] Priestly. Loc. Cit.

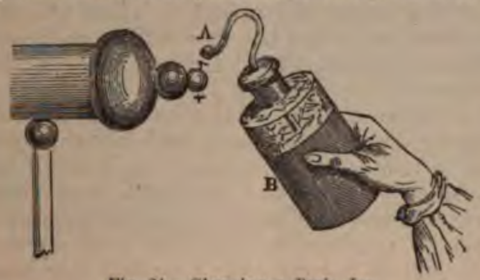

Fig. 24.—Charging a Bevis Jar.

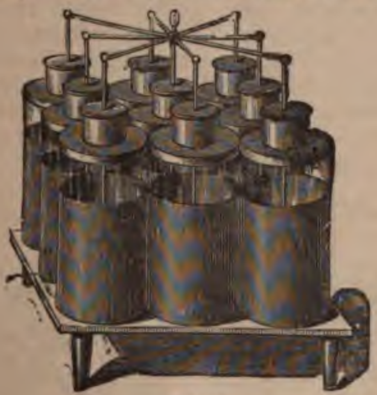

Fig. 25.

These conjectures having proved true, Dr. Bevis realized that the phial shape had no connection whatever with the phenomenon; and having coated a flat pane of glass nearly to its edges with tin foil, it gave him a spark or shock as powerful as would be given by a bottle of equal area. Such a plate, vertically mounted, is called a Bevis plate, and a number of them combined, constitute a most powerful battery.

The Bevis plate was a favorite form of the Leyden jar with Mr. Benjamin Franklin, who, later, discovered it independently, and who contrived an amusing modification of it that he called the magical picture. He says: "The coatings being concealed beneath the parts of an engraving, suppose of the King (God preserve him)! let the picture moderately electrified, be held with one hand by a person who shall attempt to remove the crown from the King's head with the other. He will receive a terrible blow and fail in the attempt; and, if the picture were highly charged, the consequence might be as fatal as that of high treason for the spark makes a hole through a quire of paper which is thought good armor against a bullet, and its crack is exceeding loud," but, he adds in a note: "a hen is the largest animal we have killed by it." A form of the device called the "miser's plate," is shown in Fig. 26. Informed of its success, Dr. Watson coated large thin jars, both internally and externally with silver leaf, and thus finally established the well known form of the common Leyden jar. Fig. 27

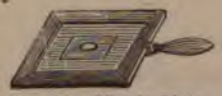

Fig. 26.—Miser's Plate.

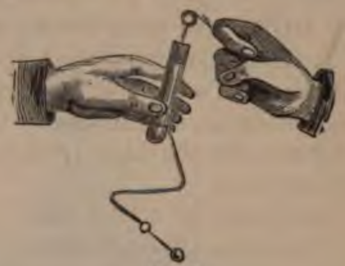

Fig. 28.

Wilson, Canton, Franklin, and Nollet, also discovered many of these facts, and others; which led to the inference, that in the discharge of a jar, the electricity traversed a circle of conducting matter from its inside to its outside coating. Thus, in Figs 23 and 28, which show the earliest and latest methods of taking the shock, the arms and body of the subject form the conducting circuit. Dr. Watson, by a celebrated experiment, proved that this circuit might include miles of wire, and observers at its opposite extremities; yet both would receive the shock apparently at the same instant.

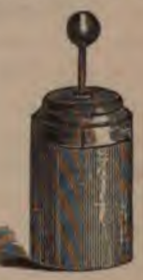

Fig. 27.—Watson's Leyden Jar.

Not, however, until Benjamin Franklin devoted his clear mind to the analysis of its phenomena, was the mode of operation of the Leyden jar comprehended. He first showed that the inside and outside were oppositely electrified, and invented a semi-circular wire with a handle of sealing wax, which he touched to the "hook" and outer coating respectively, of an insulated jar, and thereby discharged it, thus proving that no electricity passed in the discharge of a jar except from one coating to the other. Franklin's wire has become the discharger, Fig, 29, and the manner of using it is shown in Fig. 30.

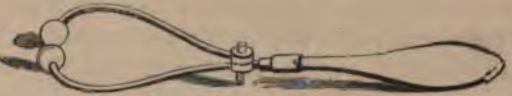

Fig. 29.—Jointed Discharger.

But to further demonstrate that the inside and outside were oppositely electrified, Franklin tried other famous experiments. A metallic ball, communicating with the external coating of a jar, was placed near the one communicating with its interior, "a cork ball suspended between these two knobs swung incessantly from one to the other;" that is, "it fetched and carried fire from the inside to the outside of the bottle, till the equilibrium was restored." Or, the silk thread being fine to imitate a web, he says, "we suspend upon it (instead of the little sphere) a counterfeit spider made of burnt cork, with legs of linen thread, and a grain of lead stuck in him to give him more weight. He will immediately fly from one ball to the other, playing with his legs against them in a very entertaining manner, for an hour or more, in dry weather, and appear perfectly alive to persons unacquainted."

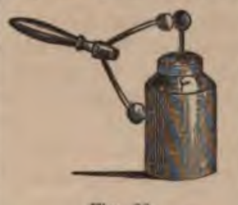

Fig. 30.

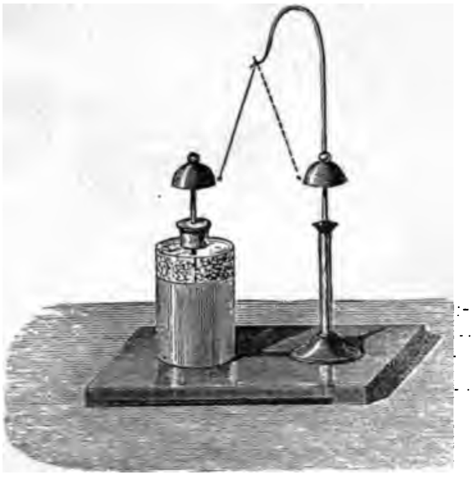

Fig. 31.—Alternate Discharge.

As an adaptation of the electrical chimes, Fig. 31, this application of the pendulum is still in vogue for illustrating the principle of alternate discharge; but Franklin's most ingenious invention, described for this purpose in 1748, was the electrical jack,[4] a circular Bevis plate, mounted horizontally on a vertical axis, having little balls at equal distances upon its circumference, and connected alternately with its opposite coatings, and caused to revolve by the attraction and repulsion between these balls, and an equal number fixed closed to its edge upon columns in a circle around it. For this wheel, revolving with astounding velocity, Franklin anticipated many practical applications, but not one has yet been devised.

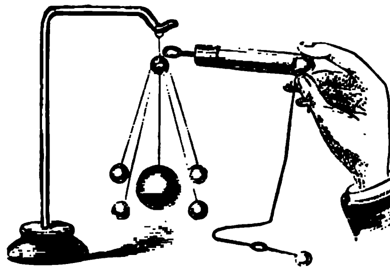

Fig. 32.

The electricity upon either coating of a jar, was shown by the repulsion of pith balls, as in the modern arrangement, Fig. 32;[5] and later, by the repulsion of the pith birds, in the now well-known device of the electrical sportsman, Fig. 31; and the precise equality of the opposite electricities accumulated by their complete collapse upon the discharge of the jar. In the latter case, the gun of the metal sportsman forms part of the conductor, and by its apparent discharge the entire flock is brought down.

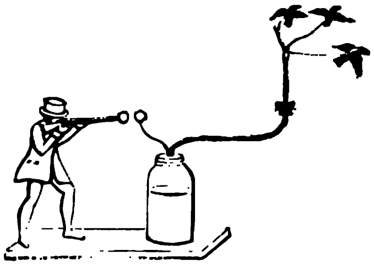

Fig. 33.

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[4] Franklin's Life, by Jared Sparks. Letters. Vol. 5. p. 306. Marquis de Courtanvaux on Franklin's Electrical Wheel. Journ. de Phys. Vol. III. p. 272. Pl. I.

[5] Due to Mr. Curt W. Meyer.

UNDERGROUND CABLES.

To the Editor of the Electrician:

ONE of the most interesting features of modern telephone line constructing, is the laying of undergroun cables. On account of the rapidly increasing number o air lines in large cities, the laying of underground cables wil soon become the rule instead of the exception.

A three and one-half mile cable has recently been laid i Boston. This cable was composed of three gutta-perch covered conductors of No. 18 copper wire, around which 1 hempen cord wire wound spirally, and the whole covered b a paraffined hemp tape, two inches wide, also wound spirally so that the edges overlaid each other about ¼ of an inch

An iron pipe was laid at the depth of about two feet through which an iron wire had been run to be used t pull the cable through by. At about every 700 feet alon this pipe, wooden boxes were placed for convenience i testing, and also to make the splices in, when the cabl had to be cut.

The reel, containing about 1¾ tons of cable, was placed at the end of the pipe, the cable spliced to the iron wire, and pulled through the first 1700 feet without difficulty The cable was then cut, and the reel moved to the nex section. The longest length pulled in without cutting wa 2,250 feet.

A curious thing was noticed in testing (by telephone) When two wires of the cable were used, making a metalli circuit, no disturbance from induction was noticed; but when only one wire was used, using the ground for return the continuous clatter of telegraph instruments, and occasionally faint talking could be heard. On one occasion th words "Hello, Jim," were distinctly heard at both ends o the line. The line is now in good working order.

Boston, December, 1882.

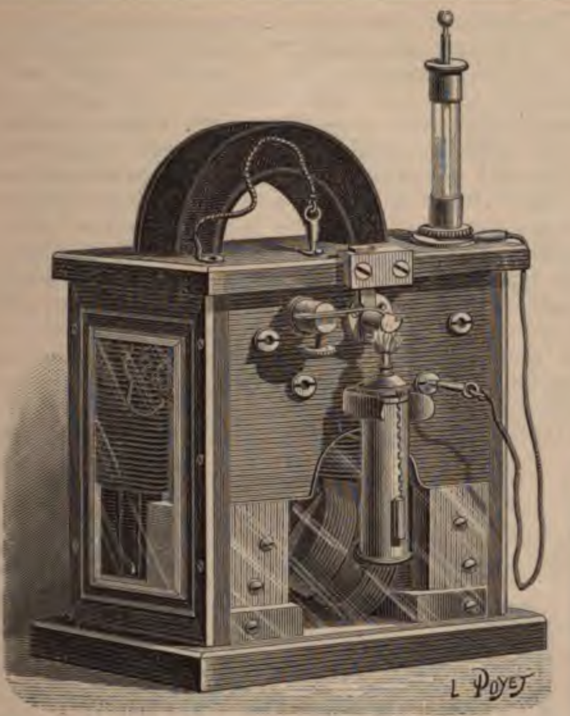
A SUBSCRIBER.

THE SPARK.

THE Spark is a small, simple electric generator, capabl of various adaptations, such as a lighter for gas o spirit lamps. as a medical apparatus, as an amusing physica apparatus, as an electric bell generator, etc., etc.

In construction it partakes of the character of both th magneto-electric and the dynamo-electric machine. It consists chiefly of a horse-shoe magnet, which serves also a a handle, between the poles of which a little Siemens armature may be rapidly rotated by means of a crank an train of cog-wheels. The currents developed in this armature, and collected by a Clark commutator, travers fixed coils placed upon the branches of the magnet, an act to reinforce its magnetism; thereby not only augmentin the power of the magnet, but also keeping it saturated. B the rotation of the crank the circuit is broken and powerful induction currents produced, and consequently ver hot sparks, which easily ignite a spirit or gas lamp place suitably near the eccentric which breaks the current. Th same apparatus, slightly modified in form, may be used i connection with gas or petroleum vapor engines to ignit the explosive mixture.

The apparatus is completed for medical use by a littl induction coil contained in the bottom of the case. Th number and power of the shocks is regulated by th rapidity with which the crank is turned. The same coi will also operate Geissler tubes and a series of experimenta or entertaining apparatus. It is a great advantage to b able to provide young people with such a source of instruction and entertainment, and yet avoid the use of bat



teries and acids, for care and precaution are by no means qualities that they largely exercise.

Because of the various applications of which it is capable we have thought it useful to describe this little apparatus.

A NOVEL CONDENSER.

THE agent of a Massachusetts cotton mill, when about to make a personal examination of some matters relative to the water power, had put on his rubber leggins, when the treasurer made his appearance, and was escorted through the mills. After standing under a large belt for a few minutes, the agent touched the treasurer's shoulder, and gave him an electric shock, which nearly overturned the man of money. The rubber boots, and the man inside of them, formed a large Leyden jar, whose discharge was very severe, especially to a person expecting nothing of the kind

NEW INSTRUMENTS FOR MEDICAL AND SURGICAL APPLICATIONS OF THE ELECTRIC CURRENT.

DOCTOR BOUDET, of Paris, has published in the "Medical Review" a very good series of articles upon the application of electricity to the diagnosis and treatment of diseases; and it is to be desired that he will extend them to a work which may be widely circulated and serve as a "*vade mecum*" for all physicians who profess to occupy themselves with electricity; not that these articles could replace exactly a treatise on "Electropathy," but they would constitute a good foundation for the study of the subject, and advantageously replace the preliminary considerations which constitute the usually worthless introductory chapters to all works on medical electricity.

We wish not to convey the impression that these articles are beyond criticism in certain of their minor details, but to call attention to the new contrivances described by Dr. Boudet as appropriate for certain specified cases which, it seems to us, must render valuable service.

I.

The employment of electricity to produce thermic effects has been already frequently resorted to[1] with advantage; but it is not the effects of galvano-cautery, but those of revulsion that are first presented to our attention. These are usually obtained by separate discs or pads, that are applied upon two distant parts of the body. From this usual disposition arises the following inconveniences: the tissues interposed between the two pads are all submitted to the action of the electric current; and it is possible for derivations to occur within the organism, which may produce, in certain cases, most disastrous or unnecessary results, as for instance, in cases when the operation is performed in the vicinity of *nervous* centres; further, an intense physiological action occurs at the moment of rupture, which is as much more intense as the Thermic effect is energetic, and consequently painful, and which may cause an abrupt interruption of the operation.

The apparatus proposed by Dr. Boudet, and of which he claims to make use with advantage, is composed of two concentric metal plates insulated from each other, the interior plate being a circular disc, and the exterior a circular ring. They are of about the same area, and are mounted upon a plate of ebonite which insulates and maintains them in position. In the centre of the apparatus is a wooden handle provided with a binding post which is in metallic communication with the central disc, while a second similar binding post is fixed in metallic contact with the periphery of the exterior ring. To these binding posts the battery terminals are fastened. It is shown in Fig. 1.

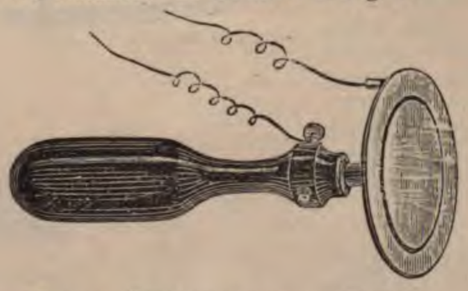


FIG. 1.—GALVANO-THERMIQUE EXCITER.

It is clear that with this device, the action must be localized at the region where it is required; and the derivations are reduced to a minimum.

The Dr. says, by varying the intensity of the current, all the degrees of revulsion can be produced upon humid integuments from that of a mustard plaster, to the formation of instantaneous blisters.

When the action is thus energetic, its duration must be strictly limited to 1 or 2 seconds.

We regret that the Dr., who himself complains of the uselessness of the terms "weak current," or "intense current," has not furnished, in this case at least, an approximate indication of the measure of the intensity of a current capable of producing such, or such an effect. Such an omission is surprising.

II.

A fundamentally, analogous arrangement, rendered necessary by the same causes, has been applied to the localization of the electrolytic action of the current, to avoid the effects of derivation. The apparatus, Fig. 2, comprises an insulating handle, which bears two insulated metal pieces, one carrying a metallic ring, and the other, supporting in its centre, a steel needle, a conical nickel-plated point, or a pad of carbon, covered with chamois or other suitable skin.

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[1] Fourcadi. Paris, 1882.

These two parts communicate, separately, with the two poles of the battery, the active pole being in relation with the central piece.

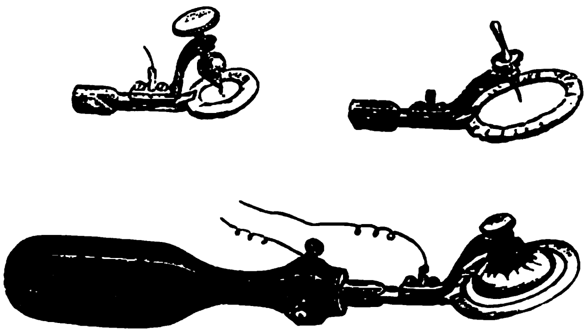

FIG. 2.—CONCENTRIC EXCITER.

This apparatus, under various forms, has been already utilized, for galvanizing the nerves or muscles of the face; for electrolizing erectile and ganglionous tumors, and even for the electrolizing of tumors of the aorta. The observations of Dr. Boudet, indicate that derived currents are effectually avoided. The intensity of the current varies from 12 to 15 milliampéres (destruction of the chalazions), up to 45 milliampéres (aneurism of the aorta).

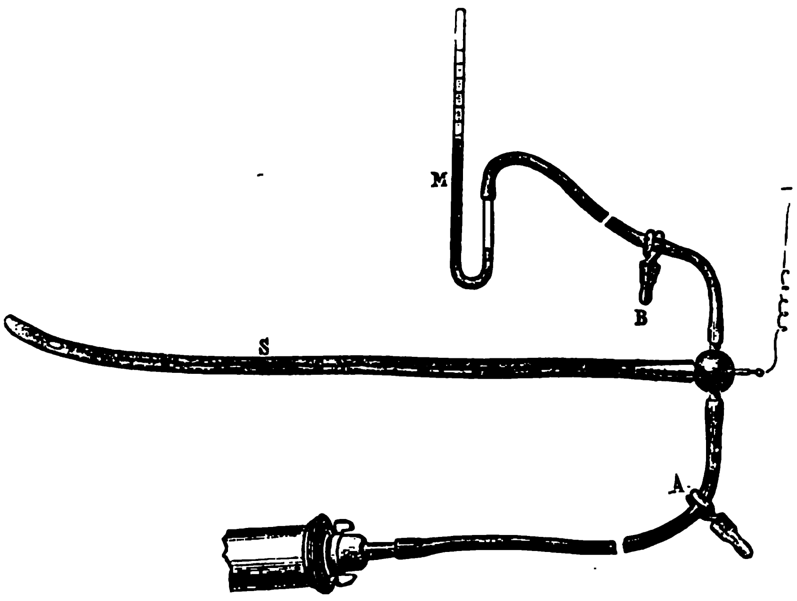

FIG. 3.—INSTRUMENT FOR BLADDER.

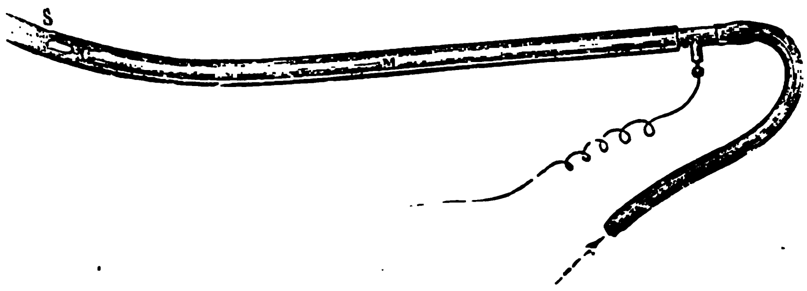

FIG. 4.—INSTRUMENT FOR INTESTINES.

III.

In other cases, on the contrary, the diffusion of the current in such a manner as to distribute its action over the largest possible surface is the object to be attained. It would be useless to occupy ourselves here, with the well known methods which are employed when this diffusion is to be produced simply on the surface of the body. But difficulties present themselves when it is desired to operate, upon the sides of certain cavities, such as the intestines, the bladder, etc. Contact, with the mucous, of a metallic instrument conveying an electric current, would cause burns, and produce serious accidents. Dr. Boudet avoids all difficulty, by the simple and ingenious method of charging the cavity with a liquid conductor, to diffuse the current to all the points that it reaches.

The apparatus comprises a hard rubber probe, larger or smaller, according to the purpose for which it is designed; in the interior of which is introduced, either a tubular metallic mandril; or, (in case the probe is to be inserted in the bladder) through the canal of the urethra, simply a platinum wire. This tube, or this wire, is chosen of such a length that its end does not quite reach the first eye of the probe, and it is, therefore, impossible for a metallic contact with the membranes to occur. This metallic conductor is put in communication with the—pole of the battery; whilst the + pole communicates with a very large plate of metal, covered with wet chamois skin, according to the indications, is applied either to the dorsal or abdominal regions. At the same time, salt water is injected in the probe by the aid of a syringe, and the salt water filling the intestines, or the bladder, is traversed by the current on its way from one pole to the other, which acts, therefore, at all points of contact between the electrolyte and the tissues.

In the case of the bladder apparatus, a manometre is added, which indicates the slightest contraction of the bladder.

The electrization of the intestines has been applied especially in cases of intestinal occlusion, and the doctor records 19 successful cases out of 31 observations. The currents of 40 milliampères can be employed without inconvenience, and in certain cases their action can be prolonged for hours.

We have described these instruments in detail, because they seem well contrived and susceptible of being advantageously employed in practice.

C. M. GARIEL, in *L'Electricien.*

A TELEPHONE supplied with a Faure secondary battery is much more perfect in its operation, than when a battery is used in the ordinary manner. The reason is supposed to lie in the fact that the secondary current is much more uniform than the current supplied by a battery. Conversation can easily be carried on with the speaker twenty feet from the transmitter.

—— M. MARCEL DEPREZ'S statements, as to the energy transmitted by electricity over an ordinary telegraph wire between Miesbach and Munich, are criticised by M. Hospitalier and others. M. Deprez claimed a return of 60 per cent.; but such a result is found to be impossible under the most favorable conditions as to insulation. M. Deprez calculates that the return is equal to the ratio of the speed, where the dynamo machines are exactly alike. M. Cabanellas has recently presented to the Academy of Sciences, of Paris, a paper, in which he holds that "in the transmission of mechanical energy by means of two identical dynamo-electric machines, the ratio of the speeds does not express the value of the return. The return is equal to the product of the ratio of the speeds into the ratio of the fields"—a theory which tends to show that only 20 per cent., instead of 60, was returned in the experiments of M. Marcel Deprez.

PRACTICAL FORMULAS FOR BATTERIES USED WITH INCANDESCENT LAMPS.

To the Electrician:

THE following formulas and example are taken from a paper by E. Hospitalier, in *L'Electricien*, of 15 June, 1882.

Let i' be the intensity of current required in each lamp to keep it white hot; let e' be the difference of potential and r' the resistance between the binding screws of each lamp, while in use. The resistance, when hot, may be roughly considered as one-half that found when cold. If we have n' lamps connected in multiple arc, the current necessary to supply them will be:

$$I = n'i' \qquad (1)$$

Let n be the number of elements of battery or accumulator required, each having an electro-motive force e, and an internal resistance r; the greatest possible intensity of current to be obtained from each will be, from Ohm's law,

$$i = \frac{e}{r} \qquad (2)$$

that is, when short circuited, but no useful work is done. The maximum of useful work is obtained when the external resistance is equal to the internal, or when

$$i = \frac{e}{2\,r} \qquad (3)$$

In practice, however, it is found more economical to make the external resistance four or five times that of the battery, to decrease the effects of polarization, and increase the *efficiency*, or proportion between the useful work and the energy expended. The practical value of i must therefore be determined by the nature of the element, its size, the length of time it is required to work, etc.

As each element or series of elements should only be traversed by a current i, q, the number of series should be such, that

$$qi = I \qquad (4)$$

$$\text{from which } q = \frac{I}{i} \qquad (5)$$

If t be the number of elements in each series, the value of I, according to Ohm's law, is

$$I = \frac{te}{\frac{tr}{q} + \frac{r'}{n'}} \qquad (6)$$

$$\text{from which } t = \frac{q\,e'}{q\,e - r\,I} \qquad (7)$$

If the resistance R of the connecting wires is large enough to be taken into account and all the lamps are in one group, formula (6) becomes

$$I = n'i' = \frac{t\,e}{\frac{tr}{q} + \frac{r'}{n'} + R} \qquad (8)$$

The value of q is the same, but t becomes larger. When the lamps are in different groups, the formula is a little more complicated.

For example, let there be 50 Swan lamps, whose constants are $i' = 1.5$ ampères, $e' = 48$ volts, r' taken hot, 32 ohms. How many Faure accumulators will be required to supply them? The constants of each element are, for a current i of 16 ampères, $r = .01$ ohm, $e = 2$ volts. The resistance of the connecting wires is supposed to be zero.

From (1), $I = n'i' = 50 \times 1.5 = 75$ ampères.

From (5), $q = \frac{I}{i} = \frac{75}{16} = 4.68$; as q must be a whole number, $q = 5$.

From (7), $t = \frac{qe'}{qe - rI} = \frac{5 \times 48}{(5 \times 2) - (.01 \times 75)} = 25.8$; $t = 26$.

Therefore, 5 series of 26 elements each, or a battery of 130 elements, will be required.

We have given i a value of 15 ampères only, in order that the polarization may not bring the electro-motive force below 2 volts. Let us suppose that the cells can be worked to their full capacity, that is, make

$$i = \frac{e}{2\,r} = \frac{2}{2 \times .01} = 100 \text{ ampères.}$$

As the lamps require only 75, $q = 1$, and t becomes

$$\frac{q\,e'}{q\,e - r\,I} = \frac{1 \times 48}{2 - (.01 \times 75)} = 38.4$$

39 elements arranged in 1 series will suffice.

A voltaic cell or accumulator may be regarded as a reservoir containing a certain quantity of electricity, but the amount available for useful work is much less than this. If we represent by Q (expressed in coulombs) the quantity thus available, the number of seconds S, during which normal working will continue, will be

$$S = \frac{Q}{i} \qquad (9)$$

since a current of i ampères equals i coulombs per second. It has been found that a Faure accumulator weighing 5 kilogrammes, will furnish 500,000 coulombs. Applying formula (9) to the first solution of the example, where $i = 15$

$$S = \frac{Q}{i} = \frac{500{,}000}{15} = 33{,}330 \text{ seconds} = 9 \text{ hours } 15 \text{ minutes.}$$

In the second solution, provided each accumulator could furnish 500,000 coulombs before e falls below 2 volts,

$$S = \frac{500{,}000}{75} = 6{,}660 \text{ secouds} = 1 \text{ hour } 51 \text{ minutes.}$$

A comparison of the length of normal working in each case with the number of accumulators, shows a decided advantage in favor of the smaller value of i, although the total energy given out by each cell is the same in both cases. The resistance of the 50 lamps is .64 ohm; of the 130 cells, .05 ohm; of the 39 cells, .39 ohm. In the first case work has to be done against .69 ohm resistance; in the second, against 1.03 ohms. Therefore, to give the current a strength of 75 ampères, an electro-motive force of 52 volts will suffice for the smaller resistance, while 78 volts are necessary for the larger.

FRED. W. STONE.

THE ELECTRO-CHRONOMETRIC INDICATOR,

OF MR. THOMAS, OF BRUSSELS.

THE problem of electric horology is one so complicated and delicate, that, although a great number of solutions of it have been proposed, it is impossible to say which is the most perfect or even most practical.

It was shown by numerous examples, presented during the Paris Electrical Exhibition, that, in electro-horology the current serves three distinct purposes, as follows:

1. The electricity may serve, instead of the customary spring or weight, as motive power for a clock pendulum. In this case its application presents the least interest or utility, although in one or two instances the electric current is so ingeniously applied that the pendulum will swing for two years without being touched.

2. The electric current serves for the transmission of time. In this case a central clock momentarily closes a circuit at every second, half-minute, or minute of time, and transmits an electric impulse to one or several dials, distantly located, the hands upon which advance a second, half-minute or minute, respectively. Such apparatuses are called *Electro-chronometric Indicators*[1].

3. The electric current is employed to regulate a number of ordinary clocks, or dials, actuated by the usual weights or springs, and every one, six, or twenty-four hours, it places the hands of all the dials in a circuit in synchronism with the hands of a central regulator, and thus corrects the slight inaccuracies they may develop between two succeeding regulations.

This is the system of periodical regulation adopted by the city of Paris for its public clocks.

Although we do not propose to discuss herein the advantages or inconveniences of these two systems, the former system of distributing time in a city, by chronometric indicators, has some special advantages, which cannot be claimed for the latter. The pneumatic clocks, which have been successfully operated in Paris for more than two years, are "compressed-air chronometric indicators." An effect which can be obtained pneumatically should be easy to obtain electrically, and at an unlimited distance from a single operating station.

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[1] A system of this description is in use at the Cooper Union, N. Y.

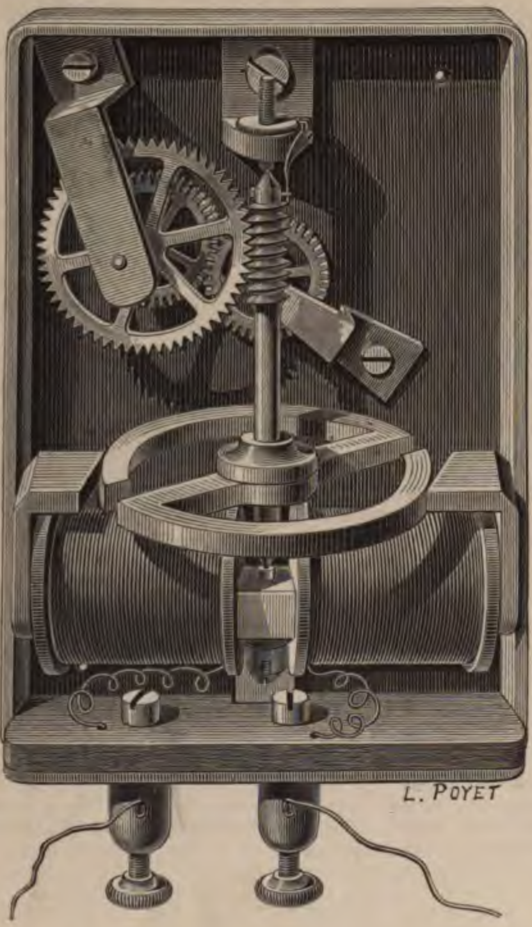
We wish now to describe a chronometric indicator of great simplicity, which accurately attains the purposed end, that is to say, it operates *surely* at the desired moment, under the influence of electric impulses transmitted by the central distributing regulator.

All chronometric indicators, so far devised, are actuated by the operation of an oscillating armature, solicited by an electro-magnet and restored by an antagonistic spring; or else by the electro-magnets acting on a polarized armature.

The movement of the armature is transmitted with extreme accuracy by levers or catches, adjusted with most careful delicacy, and which cease properly to act as soon as they obtain a little play by wear or oxidation.

In order to utilize a very limited motion of the armature it is necessary, therefore, to elongate the levers beyond measure, and chronometric indicators of this system do not accommodate themselves to the tremor, to which in many buildings they must be subjected.

All of these inconveniencies are avoided in the mechanism of the Thomas indicator, which is represented in the subjoined cut.



It consists of a straight electro-magnet, the poles of which are prolonged at right angles to the core by two armatures, which clear the spool, and are again bent at right angles toward each other, close to the spool and parallel with the core. Between them there is left a space wherein a permanent magnet, in the form of an S, is supported upon a vertical axis.

This axle carries an endless screw which engages with the train of wheels that drives the hands. Every half-minute a current is sent through the electro-magnet by the regulator, first in one direction and then the other, alternately. The direction of the current is so determined, that, each time it develops in each armature of the electro-magnet a polarity of the same kind as that opposed to it by the contiguous pole of the S magnet. The nearest or like poles of the S magnet are, therefore, repelled, and the most remote or opposite poles attracted, whereby a half revolution of the S magnet is determined, which brings the unlike poles of the two magnets in juxta-position. The current is permitted a duration of two or three seconds, in order that the S magnet may attain its position. When the electric current ceases, the influence of the S magnet causes the electro-magnet to maintain, temporarily, the polarity it had acquired, and to act as a magnetic break, which holds the S armature in position.

The transit of the succeeding current in the reverse direction inverts the polarization of the electro-magnet, and causes the S magnet to complete its revolution, and so on. The endless screw engaged with the train of wheels carries the hands forward at each movement.

In virtue of its inertia, the S magnet tends to fly past the position of equilibrium. To obviate this inconvenience, the velocity it has acquired towards the end of each half turn is retarded by a pin inserted in the axle of the endless screw, which rubs against a flexible strip of metal depending from the frame above.

This simple and ingenious apparatus requires no further regulation. The rotation is produced, whatever may be the distance between the extremities of the S armature magnet and the electro-magnet, and this distance can vary between one and three-twentieths of an inch.

The electric force acts (through the electro-magnet) upon the long arm of a lever, (the S magnet) while the effect is transmitted by the short arm of the lever, (the endless screw) which is the inverse of other gearing.

The power of the apparatus may be graduated by the dimensions of the S magnet, and of the electro-magnet, and by the size and length of the wire which surrounds the soft iron core. By augmenting the intensity of the battery employed, a great number of clocks may be included in one circuit, and dials of six feet in diameter may be associated in circuit with the smallest clocks.

At the Brussels exhibition, where the chronometric indicator of Mr. Thomas was first shown in operation, the same circuit included a great dial 4½ feet in diameter, and 18 smaller dials from 1 foot to 14 inches across.

They all operated steadily, except upon five or six occasions, when the controlling regulator was temporarily stopped, but all who visited the Brussels exhibition are aware that the floor vibrated so, that the other clocks were constantly stopping.

Knowing that a hand indicating the minutes amply suffices for the use of the public, that the emission of the current continues only three seconds, that is to say, one twentieth of the total time, and that the electric energy expended by the indicator is extremely feeble, we ask, "what is to prevent the economical distribution of time by electricity?"

By taking advantage of the $\frac{19}{20}$ of the time, during which no electricity is expended, to charge accumulators at the central station, an establishment provided with a gas engine of four horse power would produce enough electricity to actuate 25,000 electro-chronometric indicators, in a district having a radius of 20 kilometres (12 miles).

What other systems are there, that to-day, can do as much? —*L'Electricien.*

TRANSFORMATION OF STATIC ELECTRICITY INTO VOLTAIC CURRENTS.

A VOLTAIC current sent through a conductor causes, by induction, it is well known, a contrary current in a closed parallel circuit that is near. On removal of the inducing current, there is generated in the same circuit a current of direction opposite to that of the first. If the resistance of the induced circuit be considerable, the two currents thus generated have the character of electricity of tension, and may reproduce the effects of ordinary electrical machines. This is the theory of the Rhumkorff coil.

Such being the case, it was natural to inquire if the system were not reversible; if, in other words, on sending through the fine wire of a coil the discharge of an ordinary electric machine, there would not be generated in the thick wire an induced current of very small tension, and similar to voltaic currents.

It was in 1875 that Bichat made his first experiments in this relation. He was able, with a Holtz machine and a Rhumkorff coil, to decompose water and to deflect permanently the needles of a galvanometer. He stopped there, either failing to see all the importance of his discovery, or drawn to other work which seemed more pressing.

For the experiment just described to succeed, the electric discharges must be pretty strong. Without this condition (which is easily realized with condensers), the effects of the induced current are too weak to be easily observed. Another condition to be attended to is not to allow much interval between the inducing currents, destroying the quasi-continuity (a point of similarity to the voltaic current).

This induced current has indeed a character by which it is easily distinguished. Instead of being really one and continuous, it is double and dis-continuous. When the spark passes, an induced current is generated in one direction, and immediately after passsage of the spark, there is another current of opposite direction. But the rapidity of the electric discharge is such that practically these two currents seem to make but one. Another cause of discontinuity is the discontinuity of the inductive sparks themselves. Apart from these features, the generated current behaves quite like the currents produced by batteries with liquids.

Its tension is very small, and then it does not give a spark even with the least interruption of the circuit. On passing the current through the acidulated water of a voltameter, decomposition occurs, and under each test-tube a certain quantity of gas collects. As the current is continually reversed, the gas is a mixture of oxygen and hydrogen, the proportions of which vary in each experiment. By regulating suitably the resistance in the induced circuit, a means may be found (it is thought) of eliminating one of these two currents, and so of separating the gases one from the other

On putting a galvanometer in the circuit, the needle is not sensibly deflected, so long as the circuit does not present a special resistance; but if an interrupter be introduced (a Froment vibrating reed, e.g.) the needle is suddenly and permanently deflected, and this deflection is so considerable as to inspire the hope of being able to utilize the induced current.

If one of the rheophores be connected with a file, and the other drawn over the rough surface of the file, one obtains a track of reddish light like that produced on repeating the experiment with a voltaic battery. This phenomenon is not that of the spark; it is due to particles of iron and carbon, which, under action of the current, are detached from the line, fused or volatilized, and forming a sort of bridge between the asperities over which the reophore is drawn.

If the two reophores, each terminated by a very fine point of carbon, prepared for the voltaic arc, be brought into contact and then separated, one immediately sees a jet of electric light, similar to that furnished by the Gramme machines and batteries. On repeating these experiments with a conducting wire and a bath of mercury, a luminous arc is obtained, due to incandescence of mercury vapors; this arc is less brilliant, but more durable.

The induced currents circulating round a cylinder of soft iron produce in it rapid magnetizations in two opposite senses, as may be demonstrated, either by the magnetic spectra obtained with iron filings, or by the vibrations of a very mobile and very light slip.

Lastly—and this experiment is the most curious of all—the induced current generated in a Rhumkorff coil by the electric discharges may be sent into a second coil like a battery current, and will produce in that long sparks, with which all the phenomena of the Rhumkorff coil may be repeated.

These, then, are the chief results obtained in transformation of static electricity into dynamic currents. What may the future of this discovery be? If, with the small Holtz machine, which served as exciter of the current in these experiments, Prof. Govi was enabled to decompose water, redden a bad conductor, and produce the voltaic arc, we need not despair (says M. Battandier in *Les Mondes*) of obtaining powerful currents with improved apparatus, and that with a less expenditure of force. "We may even, perhaps, by multiplying or better insulating the discharges of atmospheric electricity, become master of this fluid, so capricious and menacing, and turn it to domestic use."—*Ex.*

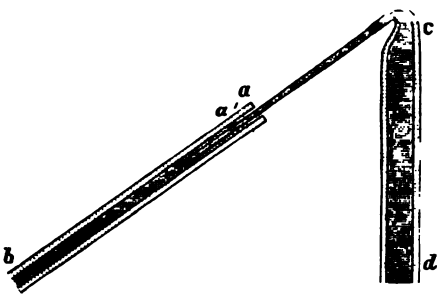
TELEGRAPHY IN JAPAN.

THE Japanese telegraph net, which was commenced in 1871, embraced, at the beginning of last year, 3,929 miles of road and 9,345 miles of wire. The total number of telegrams forwarded during the year, amounted to 1,272,756, of which 96 per cent. were written in the Japanese tongue Japanese having no alphabet of individual letters, it has been necessary, for telegraphic purposes, to make up combinations of Morse characters, representing the sounds of each of the syllables contained in the so-called Katakana. For this purpose letters of the international code have been used, and been supplemented by others made up of fine dots and strokes, which represent a total of 47 signs, minus the figures. The alphabet that had been formed in that way answered well enough for about eight years. From a school of telegraphy for the instruction of young Japanese, some 227 regular and assistant telegraph officials have been drafted, and there are now 97 students left in that institution. They are taught to speak and write English and French, and they generally receive a primary education similar to that given in England. The average charge for conveyance of twenty Japanese characters, at a distance of 60 miles, is three *sen*, or rather less than a penny. On the line from Tokio to Yokohama, the transmission takes place for seven *sen*, or about 2¼*d.*, to a distance of 20 miles. In 1880 there were open to the public 112 offices; besides these there were 70 in connection with the various departments of the State, the railways, and the police stations. There are now in use, 343 Morse apparatus, 26 Block instruments with one needle, and 29 telephones on the Bell system. In the school of telegraphy there are 71 instruments of various descriptions for practising purposes; and, in the Straits of Shimonoski, five cables have been laid.

—— THE ELECTRIC STORM on the twenty fourth of November, was very severe in Boston. In several places, No. 14 copper, and No. 12 iron, wires were melted. Several of the American Union messenger call boxes were burned. Three fire alarm boxes of the Automatic Signal Telegraph Company, and one of the annunciators of the Police Department had their connections melted. It is stated that there is no place where a connection with electric lighting wires was possible. All the telegraph lines were operated with diminished battery power, and it is claimed that some messages were sent without the use of any battery. In electric lighting, this phenomenon produced similar results. Each of the circuits of the Weston Electric Company, at their stations on Eastern Avenue and Stanhope Street, Boston, are run by four dynamo machines in series; but during the electrical storm three dynamos in series were ample to produce the number of lights, which at all other times have required four machines. The two lighting stations referred to, are about three miles distant from each other, and a number of circuits, comprising some three hundred arc lights, were operated in this manner.

AN ILLUSION—EXCEPTION TO REGULARITY OF SIPHON.

PERPETUAL motion has been the *ignus fatui* of many inventions, and a great many people to-day believe in the possibility of an impossibility being obtained. The fact would, however, at first sight seem to be obtained by the little apparatus shown in cut. Take a cylindrical capsule and pour into it distilled water to the depth of one centimetre (1/10 of an inch): put into this water one of the ends of a small glass tube .050 of an inch in diameter and about 2½ or 3 inches long. Keep the tube in a suitably inclined position, so that the water that rises through capillary attraction, will occupy a sufficient portion of its length. Then take a second tube having about 1/10 of an inch in diameter, and about 1½ inches in length. Thin down this second tube at one end, and turn back the part thus obtained so as to make an acute angle with the wide portion. Introduce the thinner portion into the upper orifice of the inclined tube until it reaches the water contained therein, and a vertical descending position to the wide portion. This can be done, either by modifying the above angle, or by the inclination of the other tube. Let us suppose, that the orifice in the vertical portion does not reach the liquid in the capsule, and that the thin part and the vertical tube are both full of water. The figure which gives a section of the top will show this more plainly.



A, *b*, is the inclined tube, and *c*, *d*, is the vertical tube. On account of the small width of the space comprised between the thin portion and the interior of the tube *a*, *b*, the capillary attraction will maintain the water near the orifice *a*, of the latter. Let us suppose that it stops at *a?* The lower end of the tube *c*, *d*, not reaching to the liquid in the capsule, this latter tube with its narrow portion will form a siphon, the shorter branch of which will be plunged in a liquid in equilibrium, and the longer one descending more than an inch below the surface of this liquid. It should appear then as if the water should continually pass out of the siphon to join the water in the capsule, and we would thus have perpetual motion.

Knowing the impossibility of this, we tried to ascertain what would really take place in such conditions.

Instead of flowing out by the tube *c*, *d*, the water ascends in it, on the contrary, and continues to be drawn up until its surface reaches a certain part of the narrow part, after which everything stops. In order that the water be drawn up, however, the orifice of the tube *c*, *d*, must be several millimetres above the liquid in the capsule. If it is lower, the tube *c*, *d*, remains full and the water suspended.

A little reflection will show the reason for what at first sight seems singular. The small surface that ends the liquid at *a*, between the two tubes, is concave transversely. By reason of this curvature it causes a suction over the liquid mass to which it belongs, that is to say, on the liquid in the tube *a*, *b*, and in that in *c*, *d*, this last communicating with the first by the narrow tube. In the tube *a*, *b*, this suction has the effect of keeping the water up to *a*, and is equipoised by the action of weight—an action that is measured by the difference in level between the small surface at *a*, and the water in the capsule. It would at first seem requsite that to have it equipoised in the tube *c*, *d*, that the difference in level between the small surface at *a*, and the orifice of this tube *c*, *d*, should be equal to the preceding, which would require that the orifice should reach the water in the capsule. But we see that the equilibrium is maintained even when the orifice is several millimetres higher. In this case the water, from its tendency to absorption, presents a slightly concave surface to the orifice, and this having a slight suction from above to below, and which combines with the effect of the weight, the suction coming from *a* is compensated. For a greater distance than that from the orifice to the water in the capsule, the suction at *a* is in excess, the liquid is drawn from below to above in the tube *c*, *d*, and the movement stops when the free surface of the liquid has reached the narrow part at a point where the suction, due to the strong concave form, equiposes that at *a*. It shows a curious instance of the action of concave liquid surfaces, and an exception to the regular working of the siphon.—*La Nature.*

SPARKS.

—— THE FIRST VOLUME of a new work on electricity, by Herr G. Wiedemann, has appeared. It is entitled "Die Lehre von der Electricität."

—— MESSRS PIETTE AND KRIZIK, the inventors of the Pilsen lamp, have been driving a threshing machine by electricity at an agricultural show in Lundenburg.

—— THE ELECTRIC LIGHT, (Weston) used at the headings of the Hudson River Tunnel has caused the grain spilled from the mule's rations to germinate.

—— ON DECEMBER 1, Annie Stadhneyer was found in an unconscious condition at No. 47 Bowery, the gas was escaping from a burner in the room when the door was opened.

—— ON DEC 19TH, a fire occurred in the large store of I. P. Lovell & Sons, of Boston; it was caused by an explosion of gas in the basement, two persons were badly injured, and the loss was $135,000.

—— THE *Telegram* recently published a list of some fifty persons in this city and twenty-five out of the city, who met death by inhaling gas through accident or design, within the last twenty-three months.

—— ON DECEMBER 5, an explosion, caused by escaping gas, in the basement of the four-story brick building on the South-west corner of Grand and Chrystie Streets, resulted in a loss by fire and water of $25,000.

—— M. GEOFFROY, a wire manufacturer in Paris, has taken a patent for covering electric wires with asbestos. Experiments, which will be repeated officially, have proved that the copper can be burnt without any spark being conducted outside.

—— LECTURING RECENTLY at Edinburgh, Professor Fleeming Jenkin said the popular mind supposed that electricity would supersede steam; but what had taken place, was, that engines were employed to produce electricity, and electricity afforded us the best means yet discovered for distributing power.

—— ON THE EVENING of Dec. 14th, Mr. John E. Pendleton gave a lecture in Boston, "On Storage of Electricity," before the Society of Arts, which was illustrated by numerous and brilliant experiments. Prof. Cross stated that it was the first public lecture ever given in which the storage battery was used.

—— DURING SOME RECENT trials, at London, of Kelway's electric log on board the steam-tug *Pixie*, a number of runs gave a mean of 7·2724 knots, while the same distance, by actual measurement, was 7·2768; the difference is thus, 0·0044, which is probably the nearest approach to accuracy obtained by any log.

—— THERE ARE ABOUT eight hundred arc lights in Boston, of which one hundred and sixteen are used for lighting streets and squares. At a public hearing before the Board of Aldermen some time ago, one of the Police Commissioners testified that one electric light was equal to five policemen in some parts of the city.

—— A PAMPHLET, describing the formation and use of M. de Kabath's electric accumulators, has been issued in English, and is supplied by Messrs. Dawson & Sons. We recently described the accumulator, which is said to offer fifteen times the surface for the same weight as the Planté. This result is obtained by the use of thin plates of corrugated lead.

—— THE VOLTA PRIZE of 50,000 francs, offered by the French Government in 1887 will be awarded to the author of the discovery which shall be adjudged to have best increased the facility of applying electricity as a source of light, heat, power, chemical action, or as a transmitter of messages; or in the treatment of disease. June 30, 1887, is the last day for receiving claims, and the prize is open to the savants of all nations.

—— THE VARIOUS OFFICES, the engine-room, and part of the works of the Amsterdam Gas Company are illuminated by Maxim incandescent lamps, the dynamo being driven by a gas engine. A battery of 36 Planté accumulators is interposed between the machine and the lamps, for the purpose of obtaining steadiness; and it is found that it is capable of supplying the current required during the night when the engine is stopped,

—— PROF. FLEEMING JENKIN has patented an electrical system of transporting goods, which he calls "Telpherage." It resembles the wire-rope system, in so far that the vehicles are supported on strained conductors, which suspend the load and at the same time convey the electric energy. There can be no collisions, as if one train gets on to a section occupied by another, it is deprived of motive power and brought to a standstill until the section is clear.

—— THE CORRECT TIME of the meridian of the State House at Boston may be obtained from Harvard College Observatory at any Western Union telegraph office by paying the price of a ten-word message from Boston. The signal consists of a tap upon the telegraph instrument every other second, and the beginning of a minute is noted by the omission of the tap upon the fifty-eight second of each minute; and twelve taps are omitted before the commencement of each five minutes.

—— AT A RECENT meeting of the Academy of Sciences, in Paris, a paper was read by M. Mascart, on the electrification of air. In the Amphitheatre of the College of France, he electrified the air by discharging a Leyden jar with a flame, during ten seconds; another flame, 8 m off, communicated with an electrometer in an adjoining hall. The maximum deflection in the latter was reached in about a quarter of an hour; then there was slow diminution, but after two hours 1-20th of the maximum still remained. The electrified gas probably rises and is diffused like smoke. To study the lower atmospheric layers, the potential should be determined in a large inclosure formed of metallic netting, connected with the ground.

—— IT IS SAID THAT a demand for persons having a knowledge of electricity and mechanical construction is being caused by the various electric light companies abroad. The Anglo-Austrian Brush Company advertise that they register applications for employment on their staff on works abroad, such as those who have had practical experience in the designing, manufacture, or installation of dynamos, arc, or incandescent lamps, accumulators, telephones, telegraphs, and other electrical apparatus, or as mechanical draughtsmen in engineers' shops, or as engineers in the construction and erection of steam engines, water or gas works.

—— IN THE LAST SITTING of the Syndicat d'Électricité, of Paris, M. Jablochkoff described a new element which he has invented, and which consists of sodium for the electro-positive plate, the negative being, as usual, carbon. M. Jablochkoff does not use any exciting liquid, but merely sends into his elements, by the instrumentality of an aspirator, a current of air saturated with moisture. He says that soda is dissolved and falls to the bottom of the box where his elements are kept so that it may be easily collected and sold at a high price, being pure except for a small quantity of carbonate and of nitrate. According to his statement the electro-motive force of this element is about 4 volts.

—— THE LAST ACCIDENT from the electric lighting apparatus is that of a severely sprained wrist, which was caused in this manner: A man with a dust pan in his hand was passing a dynamo machine, when the magnetism attracted the dust pan so suddenly, that the man's wrist was so severely wrenched that he was disabled for some time.

—— AT A recent meeting of the Physical Society, London, Prof. S. P. Thompson stated that in the *Journal de Paris* for 1802, there is a note describing the voltaic arc between carbon points, as produced by M. Etienne Gaspar Robertson, at Paris, in that year. Laboratory note books, at the Royal Institution, indicate that Sir Humphrey Davy experimented with the arc quite as early. Prof. Thompson also exhibited a telephone made by Reis, at Frankfort, in 1861, expressly designed for transmitting speech.

—— THE MAGNETISM in the field magnets of dynamo machines is so powerful that it will attract particles of iron or steel a long distance. They should not be placed anywhere near grinding machinery. A very large dynamo was ruined by attracting particles of iron from emery wheels, thirty feet away, and separated by a partition through which were numerous belt holes. The iron dust accumulated upon the holes of the magnets, and wore the insulation from the wires of the armature revolving in front of them.

—— ONE RESULT of the Munich Electrical Exhibition, has been the formation of a (so called) Consortium or company, with a view to promoting the application of electricity to practical requirements. It is presided over by Herr v. Maffei. In the first place, where the introduction of electro-technical methods is regarded as possible, the company will offer a helping hand, either by directly undertaking to work out the problem proposed, or by initiative inquiry into the utilization of coal beds, water power, etc., for electro-technical purposes. Next, assuming necessary help to be given by the State, by cities, societies, and scientific corporations, it is proposed to found an *Electro-Technical Experimental Station for Bavaria*, the object of which will be to give authorities and private persons, contemplating electro-technical arrangements, opportunity of informing themselves as to the questions involved, and different systems, on the basis of impartial experiments, and of obtaining a satisfactory idea as to cost and feasibility of arrangements proposed. Opportunity will also be given for testing new machines and apparatus.

BUSINESS NOTICES.

THE subjoined letter being one of a number most kindly sent us recently, we publish with much satisfaction, and have no doubt it will interest our patrons:

HARTFORD, Conn., Dec. 12, 1882.

Williams & Co., 115 *Nassau St., N. Y.*:

GENTLEMEN—Wishing to express my esteem for your paper, would say that from the three insertions of my advertisement I have received over 200 replies, some of them having already ordered, who state they saw advertisement in the ELECTRICIAN, and do not doubt that others came from the same source.

By all means keep my space for me.

Yours truly, A. H. EDDY.

MESSRS. BURKE, FRASER AND CONNETT'S "Quarterly Circular of Information and Advice about Patents on Inventions, published for the free use of their clients," for December, is particularly interesting, containing valuable articles on "A Few Mechanical Movements, Patents in France, A Warning to Inventors, The Duration of United States Patents, The United States Patent Law," etc., etc.

WANTED—RESPONSIBLE POSITION, by an Electric Light Engineer, of several years' experience in arc and incandescent lighting with two of the largest companies in America and Europe. Good Mathematician and Mechanical Engineer; accustomed to calculate Dynamos, etc.; acquainted with the manufacture of all kinds of electrical light apparatus. Address "Enquirer," office of ELECTRICIAN, room 55, 115 Nassau St., New York.

PATENTS FOR NOVEMBER AND DECEMBER, 1882.

NOVEMBER 21st.

267,807 Annunciator, Electrical. F. Tanner, Detroit, Mich.
267,987 Burglar Alarm, Electrical. C. A. E. Ruebel, Chillicothe, Ohio.
267,859 Electric Machine Regulator, Dynamo. J. R. Finney, Pittsburg, Pa.
267,945 Electric Signaling Apparatus. H. W. Southworth, Springfield, Mass.
267,711 Electrical Apparatus, Commutator for. C. C. Peck and W. H. Chapman, Middleburg, Vt.
267,747 Electrical Switch Board. J. F. Gilliland, Indianapolis, Ind.
267,691 Lamp, Electric-arc. C. A. Hussey, New York, N. Y.
267,710 Pumping Apparatus, Electric. C. C. Peck, and W. H. Chapman, Middleburg, Vt.
267,978 Railway Signal Apparatus, Electric. O. Gassett, Boston, Mass.
267,979 Railway Signal Apparatus, Electric. O. Gassett, Boston, Mass.
267,860 Secondary Battery. J. R. Finney, Pittsburg, Pa.
267,804 Secondary Battery. E. F. Starr, Philadelphia, Pa.
267,878 Telegraph Key. J. T. Guthrie, Leesburg, Ohio.
267,883 Telegraph Line, Underground. C. H. Hansen, Washington, D. C.
267,833 Telegraph Sounder. J. H. Bunnell, New York, N. Y.
267,929 Telegraphic Register. E. L. Pope, Elizabeth, N. J.
267,905 Telephone Exchange, and Apparatus therefor. H. Lartigue, Paris, France.
267,897 Telephone, Mechanical. H. T. Johnson Scio, N. Y.
267,790 Telephone System. W. A. Jackson and W. R. Cole, Detroit, Mich.

NOVEMBER 28th.

268,060 Electric Cable. R. S. Waring, Pittsburg, Pa.
268,157 Electric Cable. R. S. Waring, Pittsburg, Pa.
268,158 Electric Cable, Lead Armored. R. S. Waring, Pittsburg, Pa.
268,059 Electric Cable, Submarine. R S. Waring, Pittsburg, Pa.
268,324 Electric Cables, Dividing and Branching. R. S. Waring, Pittsburg, Pa.
268,159 Electric Cables, Uniting and Branching. R. S. Waring, Pittsburg, Pa.
268,174 Electric Generator. V. W. Blanchard, New York, N. Y.
268,255 Electric Machine, Dynamo. R. H. Mather, Windsor, Conn.
268,331 Electric Machine, Dynamo. E. Weston, Newark, N. J.
268,205 Electric Machine, Dynamo or Magneto. T. A. Edison, Menlo Park, N. J
268,175 Electric Storage Batteries, Apparatus for Charging. V. W. Blanchard, New York, N. Y.
268,031 Electric Wire Conduits, Increasing and Reducing Joint for. C. Linford, Pittsburg, Pa.
268,316 Electrode, Vaginal. A. W. Tipton, Jacksonville, Ill.
268,218 Lamp, Electric-arc. A. Graham, London, England.
268,224 Lamp, Electric-arc. E. J. Harling, and E. Hartmann, London, England.
268,038 Lamp, Electric-arc. J. McLaughlin, Chicago, Ill.
268,254 Lamp, Electric-arc. R. H. Mather, Windsor, Conn.
268,155 Lamp, Electric-arc. S. F. Van Choate, New York. N. Y.
268,269 Lamp, Electric Incandescent. J. V. Nichols, Brooklyn, N Y.
268,270 Lamp, Electric Incandescent. J. V. Nichols, Brooklyn, N. Y.
268,329 Lamp Holder, Incandescent. E. Weston, Newark, N. J.
268,330 Lamp Holder, Incandescing-electric. E. Weston, Newark, N. J.
268,206 Lamp, Incandescing-electric. T. A. Edison, Menlo Park, N. J.
268,099 Magneto-electric Machine. O. Heikel, Jersey City, N. J.
2 8,360 Secondary Battery. A. K. Eaton, Brooklyn, N. Y.
268,308 Secondary Battery. E. T. and E. E. Starr, Philadelphia, Pa.
268,237 Telegraph Printing. A. F. and F. B. Johnson. Brooklyn, N. Y.
268,317 Telegraphic Circuits, Condenser for. B. Thompson, Buffalo, N. Y.
268,294 Telephone Exchange System and Apparatus. J. H. Rogers, New York, N. Y.
268,045 Telephone Toll Apparatus. J. W. See, Hamilton, Ohio.
268,359 Telephonic Apparatus. W. J. Dudley, Boston, Mass.
268,034 Insulating Compounds, Manufacture of. M. Mackay, London, England.
268,075 Insulator, Noise Deadening. G. M. Brown, Woonsocket, R. I.

DECEMBER 5th.

268,389 Electric Wires, Carrying and Conducting. W. M. Conway, Baltimore, Md.
268,392 Lamp, Electric arc. N. H. Edgerton, Philadelphia, Pa.
268,394 Lamp, Electric-arc. J. R. Finney, Pittsburg, Pa.
268,476 Railways, Traveling Contact for Electric. J. R. Finney, Pittsburg, Pa.
268,661 Telegraph, Underground. L. Haas, Chester, Pa.
26-,478 Telegraph Wire. F. K. Fitch, New York, N Y.
268,561 Telegraphic Repeater. J. P. Smithers, Brooklyn, N. Y.
268,746 Telephone, Acoustic. J. K. Stebbins, Ashtabula, Ohio.
268,554 Telephone, Head. F. Shaw, New York, N. Y.
268,630 Telephone, Receiving. G. F. Dailey, Leadville, Col.
264,523 Valves of Steam Engines, Electric Device for Operating the Throttle. J. Nesbitt, Toronto, Ontario, Canada.

DECEMBER 12th.

268,956 Electric Machine, Dynamo. E. A. Sperry, Cortland, N. Y.
268,980 Electric Machines, Armature for Dynamo. F. Bain, Union City, Ind.
269,036 Electric Machines, Armature for Dynamo A. B. Fisher, Union City, Ind.
269,082 Electric Motor, for Geissler Tubes. W. J. McCollous, Aurora, Ill.
269,085 Electrical Conductors, Conduit for. J. K. McLaughlin, Philadelphia, Pa.
269,086 Electrical Conductors, Conduit for. J. K. McLaughlin, Philadelphia, Pa.
269,092 Electrical Locomotive. E. J. Molera, San Francisco, Cal.
269,132 Lamp, Electric. W. Stanley, Jr., Englewood, N. J.
269,850 Lamp, Electric-arc. C. M. Ball, Troy, N. Y.
269,151 Lamp, Electric-arc. L. G. Wooley, Mendon, Mich.
268,851 Lamp, Carbon Holder, Electric. C. M. Ball, Troy, N. Y.
269,013 Lamps, Cut-out for Electric. C. F. Coleman, and H. A. Smith, Atlanta, Ga.
268,796 Telegraph for Railways. W. L. Hunt, Port Hope, Ontario, Canada.
269,124 Telegraph Signal Box, Automatic. P. Seiler, San Francisco, Cal.
269,130 Telephone, Exchange, Automatic. F. H. Snell, Washington, D. C.
269,030 Telephone, Mechanical. C. Egan, Zanesville, Ohio.

December 19th.

269,470 Electric Cable. W. H. Sawyer, Providence, R. I.
269,476 Electric Circuits, System for Utilizing Time Switches for. E. T. Starr, Philadelphia, Pa.
269,379 Electric Wires, Conduit for. B. Boyer, Lebanon, Pa.
269,328 Electrical Connecting Cord. W. H. Sawyer, Providence, R. I.
269,281 Electricity, Transmission of Power by. Z. T. Gramme, Paris, France.
269,331 Electro magnetic Engine. A. E. Schreiber, Brooklyn, N. Y.
269,318 Electro-magnetic Motor. C. C. Peck, and W. H. Chapman, Middlebury, Vt.
269,273 Fire Alarm and Extinguisher, Electric. C. A. Evans, Upland, Pa.
269,239 Incandescents, Treating. M. M. M. Slattery, New York, N. Y.
269,417 Lamp, Electric-arc. A. G. Holcombe, Danielsonville.
269,453 Lamp, Electric-arc. W. S. Parker, New York, N. Y.
269,321 Telegraph Key. C. Prosch, New York, N. Y.
269,326 Telephone Repeater. J. H. Rogers, New York, N. Y.
269,225 Telephones, Automatic Magneto Signal for. W. Painter, Baltimore, Md.
269,238 Telephonic Exchange System, and Apparatus therefor. J. O. Shiras, and E. A. Eckert, Cincinnati, Ohio.

BUSINESS ADDRESSES.

Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Burnap, W. H. Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q. Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Edson's Speed & Pressure Recording & Alarm Gauges, for "Steam Dynamo-machines," indispensable for safety & economy, office 91 Liberty St., N.Y.

Galvano Faradic M'f'g Co., Electrical Instruments for Medical Use, 335 Fourth Ave., New York.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C. Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 114 Centre Street, New York.

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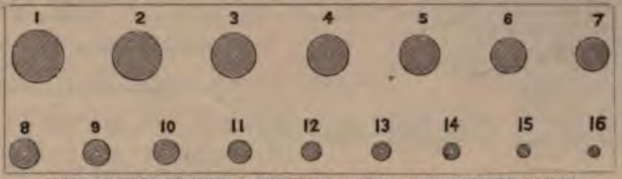

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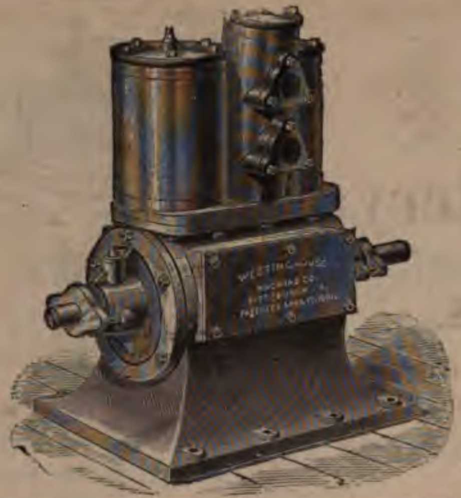

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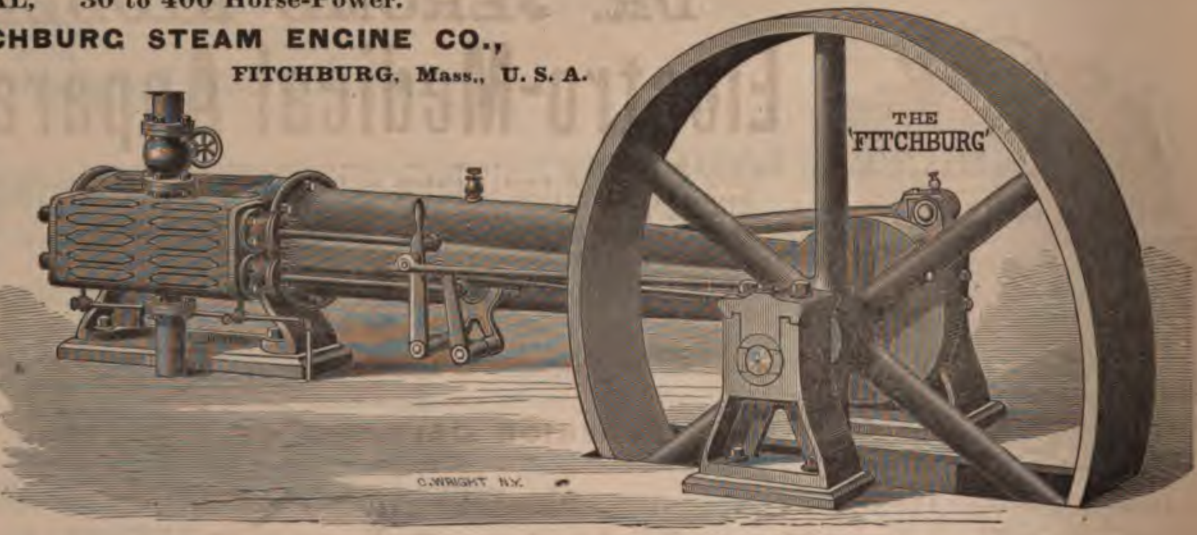

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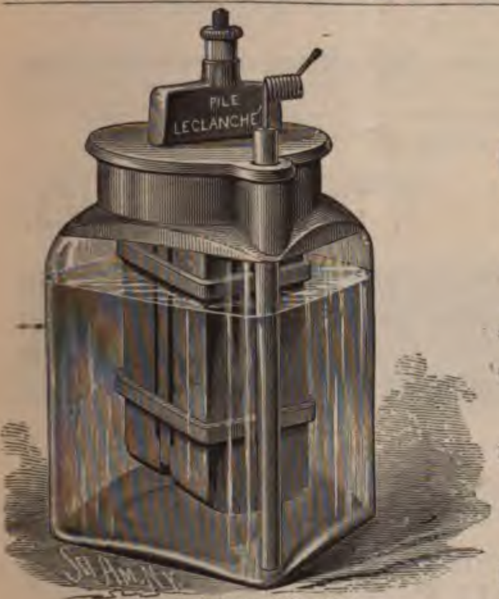

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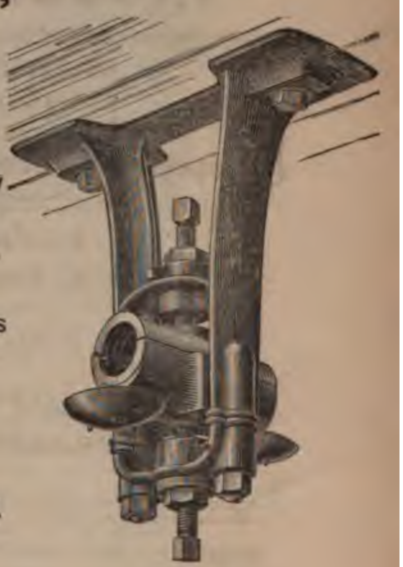

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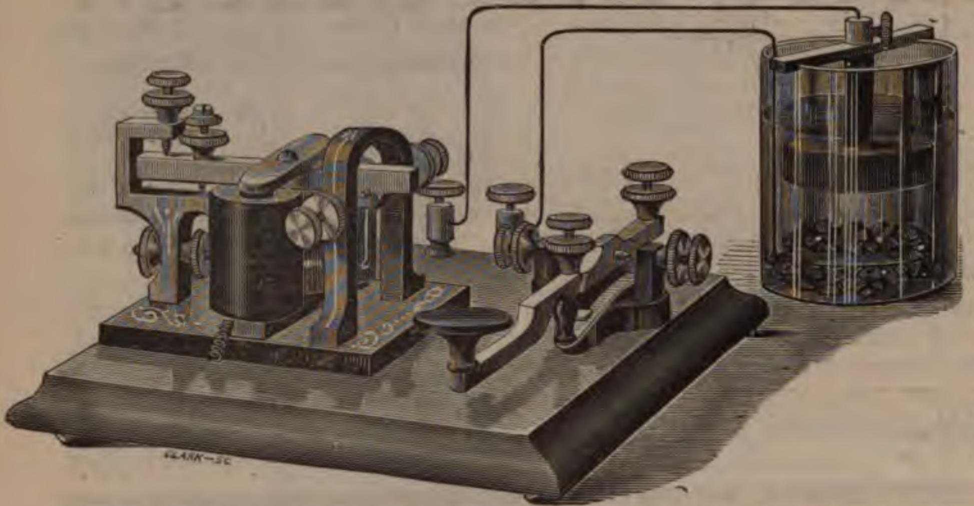

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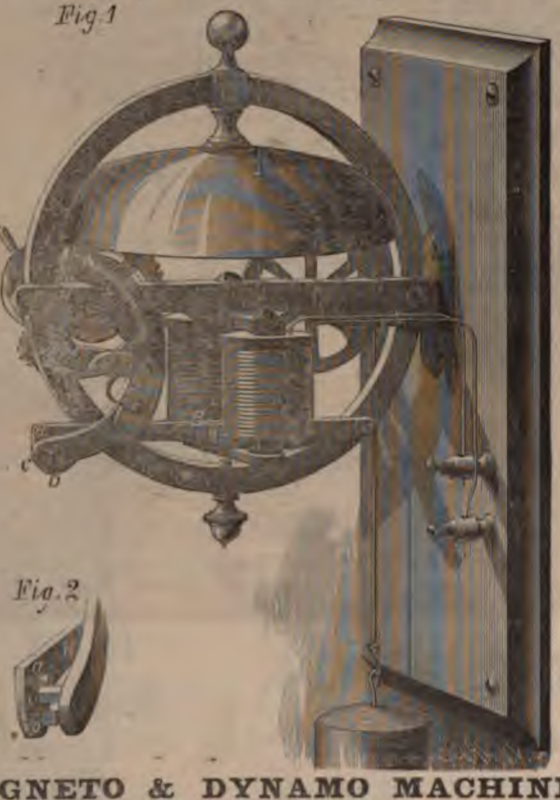

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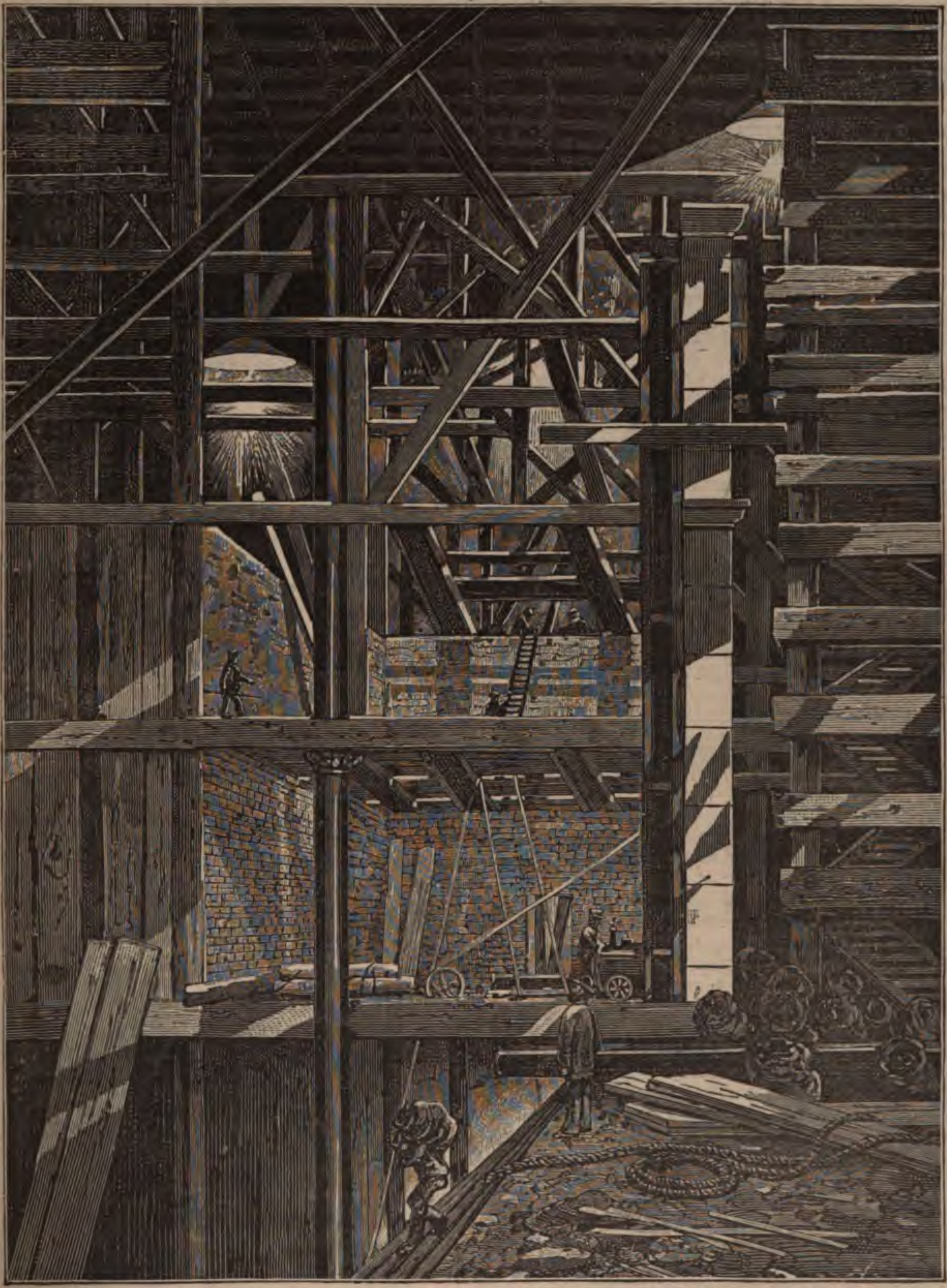


WORKING BY ELECTRICITY.—See page 30.

WORKING BY ELECTRICITY.

AMONG the despatches, recounting the Milwaukee holocaust, was the following: "To night all is dark and dreary at the scene. The authorities have not provided electric lights, despite popular clamor on the subject. Not a single body has been found yet." It may be somewhat hasty to blame the public authorities; but that philosophic spirit, which allows the victims of some great disaster to lie smouldering in a heap of ruins, until they can be slowly extricated by day light, is not one to be either commended or encouraged. How often do we not hear of mills working day and night, of night relays, and of a due appreciation of time—even night time—when money was to be gained?

Darkness adds immeasurably to the horror of such calamities, for relatives and friends have to await the sun, before the work will be gone on with. We saw this in the Potter fire building, and we are doomed to see it again, for, although our municipal departments cost more than any other in the world, they display a lamentable lack of prompt aid and charity. "There is no money for such purposes." But, there is no necessity that such works be carried on only in the day time; the electric light can as well be used for clearing away the rubbish of a fallen building, as in erecting a new one. The illustration gives an actual example of the use of the electric light for the latter purpose. It is now largely used in Paris, in carrying on building. The intense heat of a portion of our Summer season, would even render night building a most commendable innovation, for the bricklayer is peculiarly exposed to insolation—the attraction of the bricks, the dizzy height, the exposed situation, are all elements of danger.

But people, some at least, prefer to remain in darkness; this is, however, so common to human nature, that one of the Hebrew commentators draws an illustration from it. "Does anybody awake, shortly before the morning, when everything is yet in darkness, he asks a servant to give him a light, but it immediately extinguishes; then he has another lighted, and is preceded by it, but this one also goes out, and he sits in darkness again, then he thinks to himself: 'Now will I wait till the clear light of morning dawns, then I can see clearly.'"

Perhaps that has been the sentiment also of the Milwaukee authorities.

NEW TELEPHONIC APPARATUS.

FROM the first, Mr. G. Bell has insisted that telephones, in which both poles of the magnet act upon the vibrating diaphragm, at the same time give the more intense sound, and the variety called the "Carre Model," has always been considered as the superlative among telephones of this class; but as these apparatuses are not portable, and as they are far more expensive than the ordinary, little, straight magnet telephone, they are less extensively employed.

However, Messrs. Phelps, Gray, Siemens, Gower, and Ader, seeking to render the horseshoe magnet telephones portable, have created certain well known varieties, which give very good results. But since the manufacture of horseshoe magnets is necessarily expensive, and their adjustment difficult, in consequence of their distortion during the tempering process, their price has continued always relatively high, and it has been long desirable that a means should be devised of rendering the construction of these telephones so simple that they could be sold at the same price as the straight magnet telephones. This was the problem that Mr. Kotyra has quite successfully solved.

In this system, the horseshoe is constructed by the combination of thin strips of hardened steel, of different lengths, cut from the same sheet, and so associated as to form a horseshoe electro-magnet. This manufacture is easy, for admitting that two of these strips, longer than the others, and placed together, as is shown at *AA*, Fig. 1, below, can be considered as the back piece of the electro-magnet, it is only necessary, in order to form the arms and holes, to fix upon its extremities, first, very short strips of steel, or iron, and upon these to superpose other sheets of steel, *NS*, a little less than half as long as the back piece, *AA*. At the extremities of these, and some millimetres[1] apart, are fixed the two iron cores, forming a vertical extension of the two poles of the magnet, and two bobbins, or coils, *BB*, dropped over these cores, completed the electro-magnetic system, of which no part need be forged, and which being magnetized, sheet by sheet, can be given a power vastly more energetic, and durable than a solid, single piece magnet. The rest of the system admits of the same construction as the ordinary Bell system; and the instrument can be given all possible exterior forms.

Mr. Kotyra has also simplified the manner of mounting the subscribers "posts," by enclosing, in the case of the telephonic transmitter, the commutator employed to put the line in connection with the call bell, or the telephone.

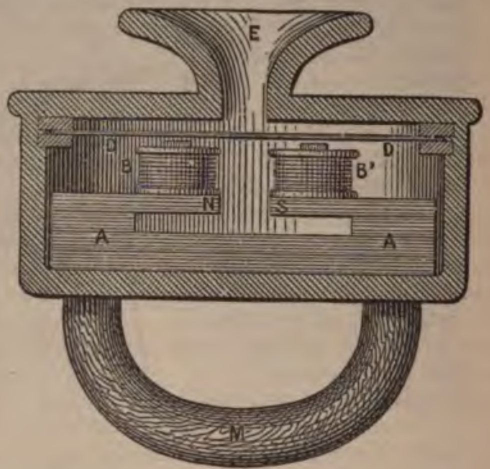


FIG. 1.

This telephonic system can naturally operate either with, or without a battery, but up to the present time Mr. Kotyra has preferred to use for the transmitter a telephone of the same system, to which he gives larger dimensions, and which he fixes in such a position that it is presented toward the speaker at a certain angle, like the desk transmitters, which are the most extensively distributed, The apparatus appears, therefore, as it is shown in Fig. 2, and the telephonic receivers are suspended on arms, extending from the inside of the circular box of the transmitting telephone, and connecting with the commutator in the same manner as in other systems.

The semi-circular handles, seen below the telephones, are made simply of wood, and have no such relation to them as the handles of the "Ader," and other telephones, which are extensions of the magnets themselves.

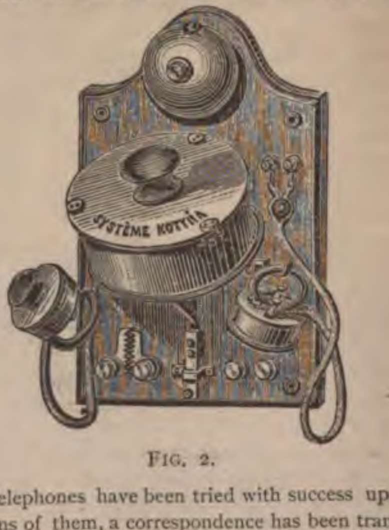


FIG. 2.

The Kotyra telephones have been tried with success upon the Northern line; by means of them, a correspondence has been transmitted from

---

[1] 1,000 millimetres — 39⅜ inches.

Paris to Creil, and it appears that the small model can be applied upon lines six kilometres (6,561 yards) in length. The inventor has, in addition, modified the disposition slightly, in order to reduce their dimensions, without diminishing their power. On the other hand, he has constructed a more powerful model, which acts upon both ears at the same time. I shall explain these improvements when the rights of the inventor are wholly protected.

D'ARGY'S MICHROPHONIC SPEAKER.

This transmitter is founded upon the same principle as that of Mr. Bourseul, of which it is, strictly speaking, merely an improved form. The Bourseul apparatus consists, as is well known, of two plates of wood, mounted parallel to and opposite each other, upon two plates of rubber, and which are connected by two little cylinders of carbon enveloped by a rubber tube. At the point of contact of the two carbons, is introduced a certain quantity of powdered coke, or other poor conductor, which is kept in place by the rubber tube, which also serves the function of pressing the two extremities of the carbons together.

Mr. D'Argy has modified this apparatus in the following manner: the two cylinders of carbon, together with the powder between them, and the rubber envelope, form a single cylinder of about one centimetre (about half an inch) in diameter, which is fixed to the vibrating diaphragm by one only of its extremities, and this diaphragm is constituted of a thin plate of spruce, forming the cover of a sort of flat box with an enlarged bottom, which is suspended vertically by two little strings—leather thongs. This box is steadied against the wall by the intermediation of four little pieces of thin cloth glued to the four corners of the box. The extremity of the carbon cylinder is flush with the exterior of the spruce diaphragm, and the whole is varnished and fixed in such a manner as to avoid any need of regulation or adjustment.

Mr. D'Argy employs no induction coil, and, if it can be believed, he obtains a very clear reproduction of the speech without any "frying" under the influence of a single little Leclanché cell, and by the use, as receivers, of common telephones, costing only fifteen francs (about three dollars) a pair. "At a distance of six metres" (about six yards) says he, "an air played by a little music box, is perceptible without the loss of a single note, but he does not indicate the distance to which transmission can be carried with this apparatus.

TELEPHONIC SYSTEMS OF MR. BOUÉ MONTAGNAC.

Mr. Boué Montagnac has been, for four years past, endeavoring to perfect the telephone and has undertaken numerous experiments, which have led him to discern certain new principles in the telephone, upon which he has based several systems of apparatus.

In the first place, for microphonic transmitters, he has recognized that, far from being necessarily impressionable to the same degree as is generally admitted, the semi-conducting contacts of multiple carbon transmitters must be susceptible to impression in different degrees. Consequently, he constructs them with carbon rods, of diameters progressively decreasing; pretending that by this disposition, if the sonorous impression is not sufficiently powerful to influence the larger, it must always be capable of influencing the smaller. On the other hand, to obtain a more decided obedience from these elements of the instrument, and at the same time to augment their sensibility and certainty, he arranges them to be movable on one side only; for, while fixed upon the frame of the apparatus, it is by their other extremities that they are put in relation by a bar of graphite, upon which they all rest, with the vibrating membrane, which consists of a sheet of cork.

The points of contact of the ends of the bars, which are fixed upon the frame, are constituted of little square blocks of graphite, isolated one from the other, and each separately communicating with a special battery. The upper cross-piece of graphite, fixed upon the vibrating membrane, is supported on the side opposite to the membrane, by a very feeble spring which conveys the current, and which itself forms microphonic contact, by reason of the pressure, more or less great, that the vibrations of the disc produce between this spring and the cross-piece. The whole is maintained in an inclined position, as in the systems, Ader, Gower-Bell, &c.

It appears, that the comparative trials of this system, made by Mr. Boué Montagnac, have shown great superiority, as regards sensibility.

The telephonic receiver of M. Boué Montagnac, is a little more complicated, for he arranges it, first, so that several induced currents are caused to act upon a single membrane; second, so that for the permanent magnets, electro-magnets may be substituted, the power of which can be regulated; third, so that his vibrating plate is made a condenser, with reference to a layer of air that is put in relation with the induced current.

To realize this disposition of its constituent parts, he employs two metallic diaphragms, fixed one above the other, and separated by a sheet of paper, and he maintains them by bands of rubber. These diaphragms, one of which is iron, and the other zinc, are put in relation with the line circuit before its junction with the electro-magnetic coils. The apparatus, instead of being circular, is oblong, to permit the inclusion, in the box below, the diaphragms of a three-pole electro-magnet covered with two superposed helices. One of these helices receives the current from a local pile, to magnetize the electro-magnet constantly; the other is connected with the line, and through it, with the zinc sheet of the condenser, constituted of the two diaphragms. According to the inventor, it appears that, under these conditions, not only can a message be heard a great deal better than with ordinary telephones, but the inclusion of the condenser in the electro-magnetic system, reinforces the sound in a very considerable degree.

With a wire three kilometres in length (about 3,280 yards), and about No 44 (about 24,000 ohms resistance), says he, "the current from my transmitter goes directly to the bobbins of the receiver, without connection with the plates of the condenser, without making it very difficult to hear a message; but when the connection is effected, then the hearing is perfectly clear. With a No. 16 wire, 265 metres (about 290 yards) in length, I can hear words just as well, whether the bobbins are connected with the condenser or not," from which fact, I infer, that for great distances the inclusion of the condenser can be very advantageous for the reproduction of words.

It is to be regretted that no experiments upon telephonic lines have been made, to positively determine the merits of this system.

Further than these single instances, telephonic developments are announced every day, which, if appreciated, might develop a more rapid progress of the telephonic art. Thus Mr. Chabirand advises us, that the large mirrors, or windows, of apartments, can be advantageously employed as microphonic organs. It suffices to insert little contacts of carbon under the wainscoting of the frame, and upon the edges of the glass, to resolve the problem. Under these circumstances, can be heard everything that may be said in the room; but the use of such an attachment can be rendered discretionary, by inserting a switch in the circuit, which may be opened or closed at pleasure.

It is certainly impossible, to foresee the extent to which future developments will progress the telephonic transmission of sound; and again and again we ask, in wonder, how a telegraphic system, whose elements are so simple, could elude discovery until this late day.

TH. DU MONCEL,
In *La Lumière Électrique.*

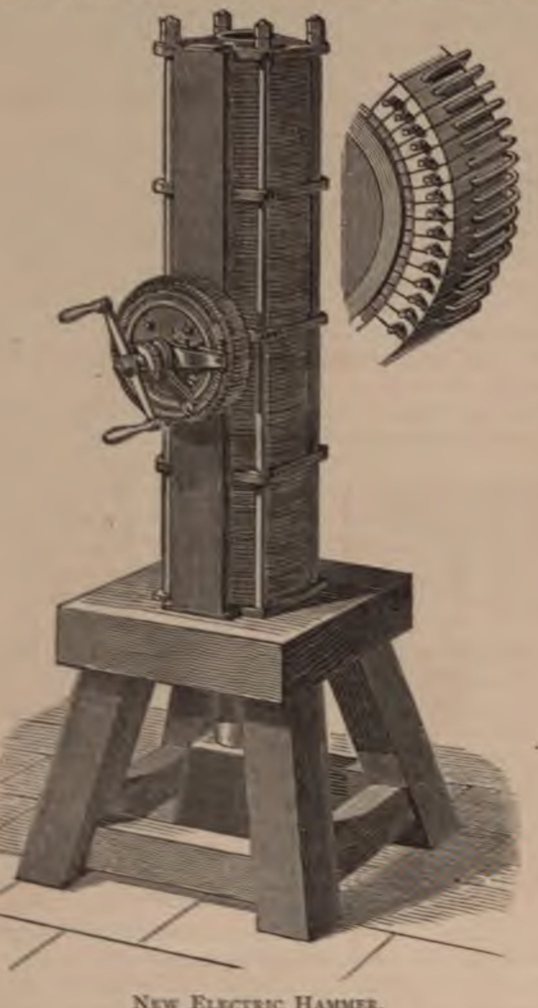
—— A YOUNG MAN in one of the outlying districts of Detroit, took an unwarranted liberty with the telephone the other day. A big bumble-bee one warm day came bumbling into the office through the window, which was open, and was caught and placed in a tumbler by the young man, and the tumbler placed over the orifice of the transmitter. He then rung up the central office, and, with the telephone to his ear, awaited the result. "Hello!" came in response from the other end of the line. "Bum, bum, bur-r-r," buzzed the bee in return. "What's that?" "Bum, boom, buzz, burr-r-r." "I can't quite understand. You'll have to repeat that." "Bum, buzz, whir-r-r," went the bumble-bee. "Oh, talk United States, you bloody imbecile! Didn't you ever use a telephone before, you idiot?" yelled the enraged operator. A renewed and more frantic buzzing was the only response. "Go to thunder, you bull-headed old fool!" came sizzling over the wire. No response. "Something's the matter with your blasted old box. I'll send a man around to-morrow to fix it," came from the central office man, and then a "click," as he hung the instrument back on the hook.

ELECTRIC HAMMER.

WE translate from *La Nature:* "Among other services that may be obtained from the transmission of electricity, its adaptation to machine tools is not the least important and interesting. This readiness of electricity to yield itself to the most varied changes, renders it one of the most valuable aids for industrial purposes."

The tendency, at present, in a large number of work shops, is to do away with ordinary transmissions, and to substitute for them a steam conduit that will bring power directly to each tool. The steam hammer is the type of this kind, and the apparatus of M. Marcel Deprez, shows that electricity can render services that have been hitherto exclusively reserved for steam.

The electric stamp hammer, represented in the illustration, must be considered as an experimental apparatus; it worked, however, during the lectures given by M. Deprez, at the Conservatoire des Arts et Métiers.



New Electric Hammer.

The electric hammer is composed of a solenoid, of 39 inches in length, formed of a series of flat superposed bobbins, forming a hollow cylinder, in which a second cylinder, weighing about 55 pounds, can freely move. The flat bobbins, to the number of eighty, are so connected together that the out wire of the first is joined to the entering wire of the second, and so on. All these bobbin connections, meet in the keys of a circular commutator, the working of which we shall see later on. The *ensemble* of the system, bobbins and commutator, represents, in principle, a Gramme ring, developed under a rectangular shape, and joined to its circular collector. Two brushes moves under this collector, forming such an angle, as to embrace about ten of the commutator keys. These keys move together, and are worked by means of a double griff, or handle. The communications between the two brushes, and an outside source of electricity, are so arranged that the current enters at one of the brushes, and leaves by the other, after having traversed the ten bobbins corresponding to the ten commutator keys, interposed between the two brushes.

Let us suppose, that at the beginning of the experiment, the cylinder, in the solenoid, is resting on the anvil, and that the current passes through the ten lower bobbins, the hammer—as we will call the moveable cylinder—will be raised to a certain extent, so as to come to the region traversed by the current, and in a certain position, that will depend on the weight of the cylinder, the intensity of the current, and the general conditions of construction.

If the commutator is turned in a certain direction, as from right to left, the current will cease passing through 1, 2, 3, *n*, lower bobbins, and will go through 1, 2, 3, *n*, bobbins above the tenth. By reason of the action of the solenoids on the soft iron, the hammer will be raised so as to come every moment into the region of the solenoid that is traversed by the current. The inverse movement of the commutator will produce the inverse effect—that is, the descent of the hammer. These movements of the hammer, and the shocks produced by the fall, may be varied in speed and power, by a suitable manœuvre of the brushes; a sudden shock may be obtained, or the hammer may be stopped so near the anvil as to break but not crush a nut; in fact, all the experiments that have been done by the steam hammer can be effected by this ingenious system. By varying the number of the solenoid sections, comprised between the two brushes of the commutator, the power of the hammer may be changed at will, and the best working conditions ascertained. With an intensity of 45 amperés, and fifteen sections interposed between the brushes, the effort developed on the cylinder will reach 152 pounds, or nearly three times the weight of the hammer. This power was shown when it was sought to make the hammer descend from the top of its run, where it was kept by the current. The wooden frame, would, of course, be replaced by a suitable iron stand. The illustration shows only the primitive machine.

ELECTRO-GENERATIVE BRICKS.

ELECTRIC candles and small bricks, or briquettes that will give both heat and electricity, may soon be a very practical form of electricity. It is not altogether out of the range of possibility, that the man of the near future may quietly remain in bed of a morning, and light by electricity his fire of electric bricks; thus saving time, rest and temper, and doing away with ashes, dust, fire-lights, wood and coals.

Dr. Brard, of La Rochelle, claims to have made a great advance in the making of such candles and bricks.

"The idea of utilizing the action of melted nitrate of potash on coal, which had been previously rendered incandescent, is not a new one," writes M. Niaudet, in *L'Electricien.* Becquerel was the first who had the idea, and made the experiment. It is very evident that, under such conditions, the coal is burned by the oxygen of the nitrate. M. Jablochkoff repeated the experiment in 1877, without knowing that it had been previously made. Dr. Brard has now repeated the same idea in principle, if not in form. He first made an electro-generative candle, but it burned too rapidly, in fact, lasting only for a moment.

He next adapted the brick form; this brick, Fig. 3, has the following dimensions: 15 centimetres long, 35 millimetres in width, and 25 millimetres in thickness. Two strips of brass protrude from it, and these are the electrodes of the pile. The skeleton of this hollow brick is made of artificial coal, composed of coal dust, that is agglomerated by means of molasses, or a paste of coal tar. This mixture is compressed in metal moulds. Metallic wires are put in the paste, and these end in the negative electrode. These wires are represented in Fig. 2. The mould is made so that the brick shall be perforated, through its entire thickness, with numerous cylindrical holes, of which Figs. 1 and 2 will give an idea. These holes are to hasten the combustion, by enlarging the surface of contact, between the coal and the nitrate. The combustive body is a mixture of nitrate (one part), and ashes (three parts). It is placed on the upper part of the brick, and kept there by means of a sheet of asbestos, of from $\frac{2}{10}$ to $\frac{4}{10}$ of a millimetre in thickness. The mixture is heated

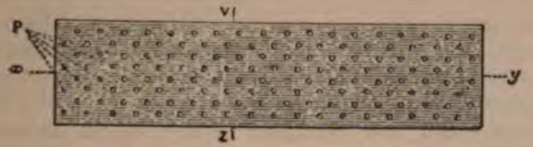


Fig. 1—Plan View of the Brick.

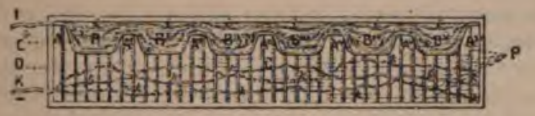


Fig. 2—Section of the Brick.

until it becomes sirupy, and then poured on the asbestos. The electromotive power of this element, is about ½ volt.

M. Niaudet does not believe much in electric bricks, or in electric stoves, but really, what to believe, and what not, are things whose number is for ever increasing.

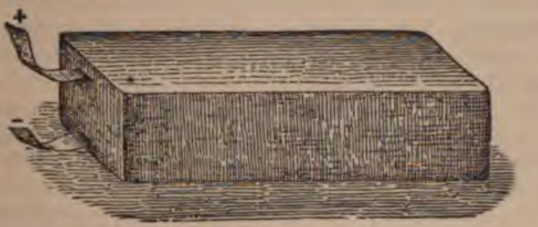
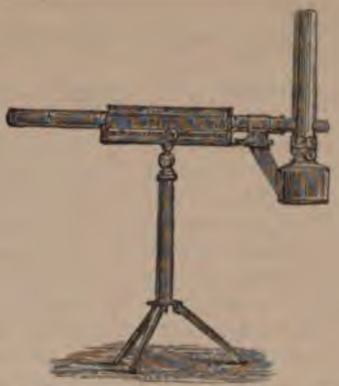


Fig. 3—The Brick.

A WEDGE AND DIAPHRAGM PHOTOMETER.

A NEW photometer, shown in perspective in the figure, has lately been constructed by Mr. Sabine. The stand supports a straight horizontal tube, at one end of which is a paraffine lamp, and at the other, an eye-piece. The middle portion of the tube is cut away, and has, slipped over it, a collar to which a frame is attached, carrying a wedge of neutral-tinted glass, adjustable by means of a rack and pinion. Inside the collar is fixed a transversed disc of ground opal glass, which the paraffine lamp illuminates to a definite degree. This disc constitutes the field of comparison, the illumination of which is adjustable by means of a series of diaphragms, of known aperture at the end, near to the paraffine lamp. At the side, between the wedge and the collar, which carries it, is a narrow pane of ground opal glass, just behind which a small mirror is fixed, at an angle of 45°, to the axis of the tube. This mirror is supported from the centre of the transverse opal disc in such a way, that the support is hidden from the observer by the mirror itself, an arrangement which insures the apparent juxtaposition of the illuminated surfaces, which have to be compared. The light to be measured is placed on the right hand side of the photometer; and the collar is turned, so that the light falls normally upon the face of the wedge, passes through the wedge, through the pane of opal glass, and is incident upon the mirror, which reflects a portion of it to the eye of the observer. The wedge is then shifted, if necessary, to interpose a greater or less thickness of absorbing medium, until a balance is obtained—that is, until the apparent illumination of the mirror is equal to that of the field of comparison, in the middle of which it is seen. If the range of the wedge, is insufficient to admit of this, the degree of illumination of the field is altered, by means of the diaphragms, and the wedge is then adjusted.

The employment of glass wedges, for photometric comparisons, is not new, having been already used by both Xavier de Maistre and Quetelet; but no practical photometer based upon this method has hitherto been constructed. The employment of diaphragms for extending the range of the wedge, is found to work well, and to enable the operator to adjust the illumination of the field with exactitude, the bright part of the paraffine flame being, of course, kept opposite to, and so as to well cover the diaphragm aperture. A table is constructed, giving for each position of the wedge, and for each diaphragm, the value, in standard candles, of any light placed at a distance of one metre from the instrument; and if the light be placed at any other distance, the number in the table has simply to be multiplied by the square of the actual distance in metres. For ascertaining approximately the amount of light which passes through any given colored glass—for example, orange glass—the eye-piece is furnished with a rotary disc, containing small panes of white and different colored glasses, either of which can be interposed at leisure.



This photometer is being made by Messrs. Elliott Bros., in two forms, one for use as a portable photometer, as shown in the figure, and the other on a more solid stand, for laboratory purposes.—*London Electrical Review.*

IMPROVED ELECTRIC BELL.

WE learn from an English paper, of an improved form of electric bell, recently patented by Messrs. Gent & Co., of Leicester, England. The main feature in which it differs from electric bells of ordinary construction, is the substituting for the armature usually moving against the face of the ends of a magnet, an armature suspended over its projecting poles. As seen in the engraving, they are inclined so as to present a large magnetic surface; while, by this mode of suspension, the armature rests with its face at equal distances from the face of the projecting poles at all points—the peculiar form of spring allowing the armature carrying the hammer to approach at a uniform angle. The power exerted upon the armature is said to be greater than in the ordinary form with a smaller quantity of wire in the coils, sufficient power being obtained to powerfully ring a 4-inch or 5-inch bell, with a magnet, whose core is only a quarter of an inch in diameter, and wound with about three ounces of fine wire.

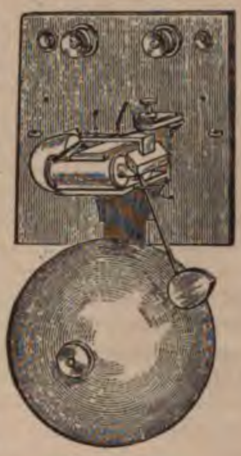


Fig. 1.

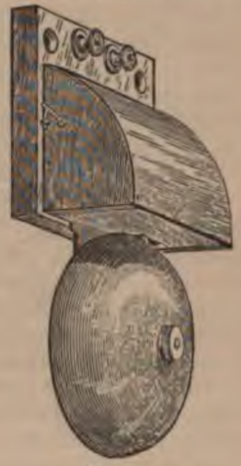


Fig. 2.

The whole is mounted on a metal frame, which is itself attached to a small wooden back, the magnet being enclosed and shielded from dust by a quadri-circular cover. As we understand that the cost of the improved bell is, especially in the larger sizes, less than the ordinary forms, it will no doubt meet with the favor it deserves.

ON LIGHT AND THE EYE.

On the 28th of December, Prof. Tyndall commenced a course of six lectures, addressed to a juvenile auditory, at the Royal Institution, London, on the above subject: Christmas juvenile lectures were begun, he remarked, by Faraday, exactly 55 years ago. Probably none of the boys and girls present had ever seen Faraday. If they had seen him they would not soon have forgotten him, and he was, no doubt, well remembered by the boys and girls, now men and women, who had the privilege of hearing him. When he was getting on to 70, he used still to call himself a "juvenile," and so Faraday was, for his heart never grew old. He always tried to make this Christmas course as simple as possible, and, Prof. Tyndall added, he would himself try to follow his predecessor's example. He should, therefore, address himself to the youngest of his hearers; but to enable the older boys and girls present to go more deeply into the subject, if they wished to do so, he had placed in the hands of every one of them his "Notes on Light," which he took great pains to write briefly and clearly some years ago. The sun, of course, was our oldest source of light. We did not know when fire was first discovered by human beings. It must have been long before history began to be written, and it was probably first used as a source of heat, and not until some time afterwards as a source of light. The means of illumination employed, at the present hour, in certain parts of Ireland and Scotland were very primitive. They took a common rush, and peeled it, so as to expose the soft, spongy pith, leaving a narrow strip of the peel behind, so as to hold the pith together. Tallow was then melted in a pan, and they passed the peeled rush through the liquid grease. Thus we had the rushlight employed, the lecturer believed, to this hour, in many parts of the United Kingdom. It was soon found, that after the first grease coat had hardened, the rush could be dipped again, and covered a second time with tallow. The process being repeated, a good, thick stem of tallow surrounded the central rush, and there, on the table, they had lighted rushlights of the kind. We had now advanced from tallow to wax, to stearine, and paraffine, as they saw, and had thus wonderfully improved candles. Wax must have been thus used in Swift's time, for in a famous fable, the witty Dean makes the bee boast, to the confusion of the spider, that whatever his own busy tribe had got, had been gained by infinite labor and research, and by ranging through every corner of nature; the difference between bees and spiders being that instead of dirt and poison, the bees had rather chosen to fill their hives with honey and wax, thus furnishing mankind with the two noblest things—sweetness and light. It was experimentally shown that the unprotected flames from our candles, gas, and paraffine lamps emit much smoke, which was eliminated when a draught was created by the use of a chimney. The brilliant Empress lamp was smokeless, though without a chimney, the draught being produced by an ingeniously contrived fan. Exceedingly hot flames had been discovered, which gave hardly any light, until some solid body was placed in the flame. Such a flame was that of hydrogen gas, which, however, at once became highly luminous, when a platinum wire was plunged into it. In the same flame a pipe shank was quickly raised to a white heat. Still more intense was the oxy-hydrogen flame, as was shown by the instant dissipation of a small round file into a shower of sparks, and of which the Drummond light was an early illustration. The fact that a platinum wire becomes more and more intensely incandescent, by the passage through it of repeated electric currents, had been known for three quarters of a century. But it was only the other day that he saw at the Crystal Palace how admirably it had been turned to account in the Lewis lamp. The platinum was here wrought into an extremely fine gauze, of which the inventor made a little cage, putting into it a very hot flame, and producing the very brilliant light which they now saw. Swan's carbon fibre was ignited in three groups by a battery of fifty cells, and, the gas having been extinguished, the theatre was afterwards illuminated by the Swan lamps presented to the Institution some six months ago. The light used for the next experiments, Prof. Tyndall explained, would dazzle the audience too much if placed naked before them, but he would cause it to stamp its own image upon the screen. The image of a pair of carbon points was then shown as passed through a pinhole first, and afterwards through a lens. A whole regiment of such points was next seen to be transmitted. The rebound of light on striking a smooth surface was demonstrated. The beam of light passed through the pinhole and could not be itself seen, but only the particles of dust in the air which were illuminated by it. On burning this dust with a spirit lamp, black specks, like smoke, were produced by the flame, which yet was smokeless. The law known to the ancients, of the equality of the angle of incidence to the angle of reflection, was demonstrated by ingenious apparatus, devised by the lecturer's assistant, Mr. Cottrell. An experiment of the same kind, as that by which Prof. Pepper produced the well-known ghost, illustrated the relation between transmitted and reflected light. Between the busts of Newton and Lord Bacon was introduced, by an optical illusion, that of Mary Somerville. The explanation of the law of the kaleidoscope, and of the laws of reflection from angular and curved mirrors, followed.

Prof. Tyndall stated, in the second lecture of the course, that, according to Foucault's later experiments, the velocity of light was more than 185,000 miles a second. This would be the distance run in 258 days by an express train traveling day and night, at the rate of thirty miles an hour. A word on shadows and penumbras or half-shadows followed, illustrated by simple experiments Owing to the motion of light in a right line, opaque bodies were found to cast shadows. A wand was fixed upright on the table with the flame of an Empress lamp turned edgeways upon it. The dark shadow was at once visible on the screen, but, as was pointed out, there was no penumbra. But on turning the flame face onwards, the shadow was dark at the core only, with a parallel streak of fading penumbra on each side. When the light emanated from a point, the shadow of a sphere, placed in the light, was a divergent cone. The bearing of these and other simple facts on the phenomena of eclipses was illustrated by diagrams. The law of actual inversion of the image in a mirror, Dr. Tyndall demonstrated in its most elementary form, by calling attention to the change in direction of the parting of his own hair as reflected in a looking-glass. He next spoke of refraction, which he expounded with constant reference to what is known as Brooke's model, illustrative of what happens when a ray of light passes from air into water. He showed that there was a limiting angle answering to the particular obliquity which caused the ray to graze the surface after quitting the water. It was next asked, what became of the rays having a greater obliquity than that answering to the limiting angle. The diagram would show that they never left the water at all, but were totally reflected at the surface, where air and water touched. The verification by experiment followed, demonstrating the phenomenon of total reflection in the circular cell, with the help of the rectangular prism. The carbon points having been inverted, a beam of light was next deflected at right angles to itself, teaching, that when light passing through water strikes very obliquely the surface, where air and water meet, it cannot escape from the water. Supposing, said the lecturer, he let water spout from the vessel to which he pointed, and supposing, further, that by means of a little glass window at the back of the vessel, he sent a beam of light through the water, concentrating it upon the orifice through which the water flowed, that beam would strike the surface of the jet of water so obliquely, that it could not escape from the water but would be carried down, just making the jet look like molten metal. The illumination of the liquid vein by internal reflection and with rays of various colors was then given, and was received with rapturous applause. The different kind of lenses were described, and their applications experimentally illustrated. In the magic lantern, to which Dr. Tyndall soon passed, there was a combination of lenses. One was used purely for the purpose of illumination, the others for the reproduction of the illuminated object in the image on the screen. The slides used for the magic lantern reproduced instantaneous and transparent photographs of the Niagara Falls, rapids, glaciers, and icebergs. Before concluding, Dr. Tyndall said, he wished to make, in their presence, an experiment on sound, bearing directly on his subject. He had there a gas weightier than air, a gas through which sound moved more slowly than through air. This gas, called nitrous oxide, would, he expected, act upon sound exactly as a convex lens acted upon light. He had also another gas much lighter than air, and through which sound traveled more swiftly than through air, This latter gas, called hydrogen, would prove, he thought, the direct converse of the heavy gas. The professor then applied these sound lenses, as he styled them, experimentally. Having shown the sensitive flame, and illustrated its behavior, he brought it near to the flaring point, when the reed sounded. He next brought a bubble of nitrous oxide in front of the reed. The heavy gas acted like a condensing lens, making the sound converge upon the flame, and causing it to flare and roar. He next experimented with the other gas, first augmenting the pressure on the gas holder outside, so as to make the flame flare when the reed sounded. He then introduced his light hydrogen lens. This gas at once scattered the rays of sound, so that the flaring flame was immediately stilled. Lastly, he shook in front of the table both the heavy bubble and the light bubble, when the one fell to the floor and the other rose to the ceiling. This experiment, he said, was important, because it showed that the waves of sound could be refracted, like light, and this prepared us for the result that light also might be due to wave motion. He said he deemed this a most striking and beautiful experiment.

ON THE HOMEING SENSE IN MAN AND ANIMALS.

L'Electricien has an article on the above subject, from the pen of M. Gariel, which will be found interesting not only to the naturalist, but to the electrician and general reader. It is herewith translated :

The *Revue Philosophique* published an article by M. Viguier some time ago, which was reproduced in *Revue internationale des sciences biologiques*, and appears worthy of a notice in this publication. We must, however, confine ourselves to one side, in giving a *resumé* of his views.

The author lays down the question very squarely at the outset. "In different species of animals, and in certain men, more or less bordering on the savage state, a remarkable faculty has been observed, which enables them to return in a straight line from their point of departure, and this after having traveled long distances and described endless windings.• There is no denial of the fact of these extraordinary returns at the present time; but there have been lively controversies and very opposite opinions as to the conditions in which they have been effected, and no unanimous views have yet been arrived at.

"We need not relate the facts proving the reality of these extraordinary returns, we will only cite that of the dog of the Archduchess Marie Régnier, which, carried *by rail* from Menton to Vienna, returned *on foot* from Vienna to Menton; and that of Captain Dunder's ass, which, brought *by sea* from Gibraltar to Cape Gata, returned *by land* from the latter point to Gibraltar. However singular these facts may appear, they cannot be gainsaid.

"Various explanations have been given, but besides that they are far from meeting the objections that will naturally arise, they do not relate to the questions treated of by this paper. M. Viguier returns to, and develops, an anonymous article which appeared in the *Quarterly Review*, 1872, attributing this quality to a special sense which endows animals with a more or less unconscious idea of the magnetic distributions at every point of the globe. Here is his full explanation :

"If we conceive that there are animals gifted with a sense, which enables them to recognize readily the direction of the magnetic north, such animals will have an undoubted idea of the north, but will not be able to return to their point of departure, unless they have an exact recollection of the length of line traversed in such or such a direction, exactly like a mariner sailing by reckoning, who has to keep inscribed the length as well as the direction of his loxodromics. But this would require a continual perception and a prodigious memory. Terrestrial magnetism will furnish us with other explanations. If we suppose that an animal is capable of perceiving the influences which affect the needle of a compass —the position of the animal remaining always practically the same with relation to the vertical of the place, it will be capable of recognizing those differences of intensity that caused the variations of the angle which is measured by the aid of this compass—an angle that varies, as is known, from 0 degrees at the magnetic poles, to 90 degrees at the magnetic equator. It could thus recognize the direction where this angle varies the most (magnetic, meridian, or isogonic line), and that where it remains steady (magnetic, parallel, or isoclinal line). Finally, there are other points of information which we obtain from our instruments, and which, we may suppose, are perceptible to an appropriate organ. I mean the variations of magnetic intensity. By uniting together all the points where this force is equally shown, we trace a series of lines (isodynamic), which are confounded neither with the isogonic or the isoclinal, although they are developed somewhat in the same way as these latter. It may be admitted, therefore, that a place may be determined by an animal, that is gifted with a magnetic sense, as complete as we have supposed, and this by the value of magnetic action in inclination and declination, as well as it would be, by us, from the intersection of a given isoclinal and isodynamic line. These magnetic conditions being once known, the animal would be always enabled to return directly to this point of departure, for it would be only by coming near it, that all the magnetic conditions would return to the value that they have in this place.

"The explanation is not absolutely impossible, but we confine ourselves to stating this curious hypothesis without trying to discuss it. M. Viguier, however, has endeavored to find out the special organ that could furnish this information, and how this organ is influenced by exterior magnetic conditions. According to M. Viguier, the organ is nothing else than the semi-circular canals of the inside ear ; they are narrow, semi-circular, and the planes perpendicular to themselves (one horizontal and two verticals). The reasons he gives for attributing this homeing sense to the semi-circular canals, are recognized by a certain number of physiologists who bring up some plausible facts in support of their theory. But, while physiologists attribute the quality to mechanical causes, M. Viguier believes he has discovered it in magnetic phenomena. He admits that terrestrial magnetism produces regular inducted currents in the endolymph of the canals, the intensity of which, varies with the position of these canals with relation to the direction of the needles of inclination and declination, and with the magnetic intensity. They would be inducted currents which the animal would feel, and which would give him an unconscious idea of the magnetic condition of the point where it is."

So far the article in *L'Electricien*, which states that the further reasons are physiological experiments which M. Viguier proposes, such as placing magnetized bars or currents near the head of a horse, by which, he believes, the animal would lose its ideas of place. Another experiment would be—with what are now termed "homeing" pigeons—some to have soft iron, and others magnetized small bars on the side of the head ; according to Viguier's theory, the latter could not find their way home. A pile placed on a horse, and sending a current to wires, or solenoids, placed parallel to the canals mentioned, would form another experiment.

THE Milwaukee hotel horror had scarcely been fully realized, when another calamity occurred. The calcium light, it should be well understood, is eminently dangerous. Some years ago one exploded in Union Square, by which a few persons were killed, and several maimed. The Vienna holocaust has had the effect of awakening the authorities to the paramount necessity of having the safety of audiences insured, as far as possible. A similar movement has taken place in Germany—many defective places of amusement have been closed, and no theatres will, in future, be allowed to be built unless perfectly isolated, with ample means of egress, heated by steam from an outside building, and with no lights, except the electric. Some New York managers do not approve of the electric light, because it may interfere with spectacular effects. The many scares that have lately taken place in New York theatres, ought to serve as a warning. The explosion in Milwaukee was another instance of that criminal carelessness, which is almost a national characteristic. However, theatrical managers, and others, should be taught that it is no venial matter not to take all human precautions, when the lives of hundreds depend upon just such measures. That there are no laws to this effect might seem rather curious, were it not that we are not accustomed to see good laws enforced. The storage of such explosive gas on a stage, was highly criminal, and the responsible parties should be severely punished.

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We call attention, in another column, to the interesting contribution of M. Ph. Delahaye, the popular writer, in the editorial column of *Revue Industrielle*, "On the Progress of Electrical Science in France, in the Year 1882."

ELECTRIC LIGHT TESTS.

In view of the conflicting claims made by the advocates of the different arc systems, now before the public, in regard to comparative efficiency, we think some consideration of the results of tests made at the Paris Exposition, may not be amiss, more especially as we are not aware that they have been hitherto published in this country. Much confusion has arisen in regard to the results of these tests, from confounding the paper contributed by Professors Ayrton and Perry, to *The Engineer*, on the subject of arc lamps, with the official report of the committee appointed to make tests and measurements of the different arc systems.

We notice that the Brush-Swan company has fallen into this error, in a circular recently issued, as the figures given correspond with those given in Professors Ayrton and Perry's report; but they do not correspond with those of the official report.

On the opposite page we publish a table, taken from the official report of Messrs. Allard, Joubert, Potier, and Tresca, the committee appointed to make tests and measurements of the various systems exhibited at the exposition. This table shows the results obtained from experiments with the different types of continuous-current generators and arc lamps, and we have added to it some additional calculations, which we have made from the data given, for the purpose of bringing out more clearly certain points, which, we think, it may be useful to consider. The data given are not as full as could be desired, and it is to be regretted that the committee was not furnished with proper facilities for testing all the different systems by the same methods, and under the same conditions; but the measurements and calculations are by far the most complete and reliable which have yet been published, and the results obtained may fairly be taken as indicating the comparative merits of the different systems before the committee, when proper consideration is given to the meaning of the figures obtained.

These systems, as will be observed, comprised the Gramme, Jurgensen, Maxim, Siemens, Bürgin, Weston, and Brush. Measurements were taken of three different forms of the Gramme machine for running, respectively, 1, 3, and 5 lamps; and three different forms of the Siemens machine, for running 1, 2, and 5 lamps; and also two different sizes of the Brush machine—the 16-light and the 40-light.

Of the measurements taken, those relating to the power applied in driving the generators, are probably less reliable than the others, on account of the different methods employed, and the different conditions under which they were taken, with the various machines. With the Siemens' machine a Hefner-Alteneck dynamometer was used, while in the other experiments the power appears to have been determined by indicator cards, taken from the engine driving the generator. The Brush machines also appear to have been driven by a different engine from that used with the others. In this connection we should take into account the fact that the French horse-power used as the unit in these measurements is somewhat smaller than the English horse-power, in terms of which our measurements are usually taken, being represented by 75 kilogramme-metres per second, as against 76 for the English.

The figures given in the table as indicating the effective power applied in driving the generator, appear to be considerably less in the case of the Brush machines, and greater in the case of the Weston machine, than those given by other observers. Mr. Brush has given, as the result of his experiments with his 16-light machine, 15.48 h. p. as the mean applied power with 16 lamps in circuit, while the corresponding figures given by the committee for a similar machine running under almost precisely the same conditions are 13.39 h. p. In view of the fact that the 40-light machine was found to be somewhat less efficient than the 16-light machine, as shown in line 18, under the head of "percentage of applied power converted into electrical energy," we should naturally expect to see in experiment No. 12, at least a proportional increase in the power expended; but this does not appear to be the case. It is to be observed, that there is considerable discrepancy between the results of experiments 12 and 13, both made with the Brush 40-light machine. Although the machine was working under almost precisely the same conditions, as to external resistance, electro-motive force, and strength of current in both cases, and the electrical energy developed was nearly the same, being 24.95 in No. 12, and 24.51 in No. 13, the expenditure of power is given as about one-seventh greater in experiment No. 13 than in experiment No. 12. We are inclined to think that the figures given in No. 13 are more reliable than those given in No. 12; especially as greater care appears to have been taken in making the determinations of applied power in experiment 13.

The figures given in the table for the Weston 10-light machine are 13.01 h. p. In the experiments made with a similar machine at the U. S. Torpedo Station, at Newport, a report of which we publish below, the corresponding figures are given as 9.48 to 9.78 h. p., with ten lamps in circuit, and other experiments have shown still lower figures.

The electrical measurements, and measurements of light are probably much more reliable as data for comparison. The photometric work, especially, appears to have been done with great care, and we are pleased to see that the mean of the illuminating power, in all directions, has been taken as the basis of comparison, as this is obviously the only fair method of indicating the amount of light obtained.

It will be observed that the measurements of light given in the table are extremely low, as compared with the results obtained by other observers; but, as they all appear to have been made with the same instruments, and by the same observers, they may probably be taken with safety as showing the relative results obtained, however unwilling we may be to accept them as indicating absolute values.

Under the head of "electrical calculations" and "results," are given various deductions, calculated from the data obtained by the measurements. We think the committee might, with advantage, have adopted a somewhat different method in comparing results obtained, so as to

Table of Experiments Made with Continuous-Current Generators and Lamps.

TAKEN FROM THE OFFICIAL REPORT OF THE COMMITTEE APPOINTED AT THE PARIS EXPOSITION.

		Formulae	1 Gramme. 1 lamp	2 Jurgensen. 2 lamps	3 Maxim 1 lamp	4 Siemens. 1 lamp	5 Siemens. 2 lamps	6 Bürgin. 3 lamps	7 Gramme. 3 lamps	8 Gramme. 5 lamps	9 Siemens. 5 lamps	10 Weston.• 10 l'mps	11 Brush. 16 l'mps	12 Brush. 40 l'mps	13 Brush. 38 l'mps
	MEASUREMENTS OF POWER.														
1	Speed of generator, revolutions per minute		475	800	1017	737	1330	1535	1695	1496	826	1003	770	700	705
2	Effective power applied—horse-power	T	16.13	21.68	4.07	4.44	5.31	5.32	8.11	8.00	5.05	13.01	13.39	29.96	33.35
	ELECTRICAL MEASUREMENTS.														
3	Resistance of generator in ohms	(r)	0.33	0.45	0.70	0.66	1.68	2.80	0.52	4.57	7.05	1.88	10.55	22.38	22.38
4	Resistance of mains (circuit without lamps) in ohms	(R^m)	0.10	0.82	0.25	0.12	0.13	1.50	1.25	0.62	4.50	1.50	2.56	2.60	7.90
5	Resistance of mains and generator	R	0.43	1.27	0.95	0.78	1.81	4.30	1.77	5.19	11.55	3.38	13.11	24.98	30.28
6	Strength of current in ampères	I	109.2	90.0	33.0	35.0	26.2	18.5	19.0	15.3	10.0	23.0	10.00	9.5	9.5
7	Fall of potential at each lamp in volts	E	53.0	58.0	53.0	53.0	44.5	41.0	53.0	49.8	47.4	32.0	44.3	44.3	44.3
	ELECTRICAL CALCULATIONS.														
8	Energy appearing in generator and mains	$\frac{RI^2}{75g}$	6.97	13.99	1.41	1.29	1.69	2.00	0.87	1.65	1.57	2.43	1.79	3.07	3.72
9	Energy appearing in one lamp	$\frac{EI}{75g}$	7.87	7.09	2.37	2.52	1.59	1.027	1.369	1.04	0.64	1.00	0.60	0.573	0.573
10	Energy appearing in all the lamps	t	7.87	6.97	2.31	2.52	3.18	3.08	4.11	5.20	3.20	10.00	9.60	21.88	20.79
11	Total electrical energy	T'	14.84	20.96	3.72	3.81	4.87	5.08	4.98	6.85	4.77	12.43	11.39	24.95	24.51
12	Mean electro-motive force	$nE + RI$	102	172	84	80	136	203	193	328	353	398	840	2009	1971
	MEASUREMENTS OF LIGHT.														
13	Diameter of carbons in millimetres		20	23	12	18	14	13	14	12	10	9 & 10	11	11	11
14	Horizontal illuminating power, each lamp, in carcels		952	607	246	210	142	50	155	112	67	92	37	63	63
15	Maximum illuminating power, each lamp, in carcels		1960	......	465	805	537	227	357	184	72	154	76	78	78
16	Mean spherical illuminating power, each lamp, in carcels	l	966	688	239	306	205	82	167	102	52	85	38	39	39
17	Total mean spherical illuminating power, all lamps, in carcels	$L = nl$	966	688	239	306	410	246	501	510	260	850	608	1560	1482
	RESULTS.														
18	Percentage of applied power converted into electrical energy	$\frac{T'}{T}$	0.92	0.97	0.91	0.86	0.92	0.95	0.62	0.86	0.94	0.95	0.85	0.83	0.73
19	Percentage of applied power appearing in the arcs	$\frac{t}{T}$	0.43	0.32	0.57	0.57	0.60	0.58	0.51	0.65	0.63	0.77	0.72	0.73	0.62
20	Percentage of total electrical energy appearing in the arcs	$\frac{t}{T'}$	0.53	0.33	0.62	0.66	0.65	0.61	0.83	0.76	0.67	0.80	0.84	0.87	0.85
21	Carcels per horse-power applied to generator	$\frac{L}{T}$	60.0	31.7	58.7	68.9	77 2	46.2	61.8	63.8	51.5	65.3	45.4	52.1	44.4
22	Carcels per horse-power of electrical energy	$\frac{L}{T'}$	65.1	32.8	64.2	80.3	84.2	48.4	100.4	74.5	54.6	68.4	53.4	62.6	60.5
23	Carcels per horse-power of energy appearing in the arcs	$\frac{L}{t}$	128.8	98.7	103.5	121.4	129.3	79.9	121.6	98.1	81.3	85.0	63.3	71.7	71.4
24	Carcels per ampère	$\frac{l}{I}$	8.85	7.64	7.24	8.74	7.82	4.43	8.79	6.67	5.20	3.70	3.80	4.11	4.11

Additional Calculations.

		Formulae	1	2	3	4	5	6	7	8	9	10	11	12	13
25	Total resistance of entire circuit, (external and internal)	$R^t = \frac{nE + RI}{I}$	.93	1.91	2.55	2.29	5.19	10.97	10.16	21.44	35.30	17.30	84.00	211.47	207.47
26	External resistance, (mains and lamps)	$R^e = R^t - r$	.60	1.46	1.85	1.63	3.51	8.17	9.64	16.87	28.25	15.42	73.45	189.09	185.09
27	Co-efficient of electrical efficiency of generator	$C = \frac{R^e}{R^t}$	.65	.76	.73	.71	.68	.74	.95	.79	.80	.89	.87	.89	.89
28	Net or actual efficiency of generator	$\frac{T'}{T} \times C$	.60	.74	.66	.61	.63	.70	.59	.68	.75	.85	.74	.74	.65
29	Percentage of external resistance in circuit wires	$\frac{R^m}{R^e}$	.17	.56	.14	.07	.04	.18	.13	.04	.16	.10	.03	.01	.04

show more clearly the comparative efficiency of the different generators, and the comparison would have been still more satisfactory, if care had been taken to subject each system to the same relative conditions when making the measurements.

A system of electric light apparatus comprises three essential elements: The generator, the mains or conductors connecting the generator with the lamps, and the lamps themselves. The resistance of the entire circuit is distributed between these three elements, and the expenditure of the entire amount of electrical energy developed, is apportioned among the elements making up the circuit, in the ratio of their resistances. It is obvious that the resistance of the generator is fixed by its design and construction, and this is also true, within certain narrow limits, in regard to the resistance of the lamp, while, on the other hand, the resistance interposed by the mains or circuit wires, may be varied at will, by varying the size or length of the conductors used.

The true measure of the efficiency of a dynamo machine is, obviously, the proportional part of the entire mechanical energy expended in driving it, which it is capable of converting into electrical energy *and delivering in the external or working circuit.* This depends upon two things; first: The proportional part of the mechanical energy which is converted into electrical energy, and, second: The proportional part of the entire electrical energy developed, which appears in the part of the circuit external to the machine. For the purpose of determining this latter point, it is only necessary to compare the resistance of that part of the circuit external to the machine, with the resistance of the entire circuit, and, for the purposes of this comparison it makes no difference how much of the external resistance is comprised in the lamps, and how much in the circuit wires.

The relative capacities of the different machines, tested for transforming mechanical energy into electrical energy, is shown in line 18. This may properly be called the gross efficiency of the machine. Leaving out of account the Jurgensen machine, which was tested under abnormal conditions, and which, as we have been informed, broke down upon the trial; and also Gramme No. 7, which, as the committee state, was afterward found to be a defective machine, the machines tested, when arranged in the order of their gross efficiency, stand as follows:

GROSS EFFICIENCY OF DYNAMO MACHINES.

Weston	10-lights	.95.
Bürgin	3 "	.95.
Siemens	5 "	.94.
Gramme	1 "	.92.
Siemens	2 "	.92.
Maxim	1 "	.91.
Siemens	1 "	.86.
Gramme	5 "	.86
Brush	16 "	.85.
"	40 "	.83.
"	38 "	.73.

For the purpose of ascertaining the real or net efficiency of the machines, certain additional calculations are necessary, which are readily made from the data given. The total resistance of the circuit, both external and internal, is obtained by dividing the electro-motive force in volts, by the strength of current in ampères, and the resistance of the external circuit, by deducting from the total resistance the internal resistance of the machine. These figures are given in lines 25 and 26, which we have added to the table.

The co-efficient of electrical efficiency of the machine, or the part of the entire current appearing in the working circuit, is readily obtained from these figures, and is given in line 27.

It will be observed that the Gramme No. 7, apparently shows the extremely high co-efficient of electrical efficiency, of .95. This is due to the fact that the machine used was of a peculiar type, termed by M. Gramme *auto-excitatrice.* By this term he designated a compound machine, having two armatures on the same shaft, and in the same field, one of which is used only for exciting the field. Of course, what is given as the internal resistance of this machine, is merely the resistance of the main armature, while with the other machines, the resistance given includes both the armature and the field coils.

The net or actual efficiency of the generator is obtained by applying this co-efficient to the figures indicating the gross efficiency, and the results obtained are given in line 28. Arranging the machines in the order of their actual efficiency, as shown by these figures, and again leaving out of account the Jurgensen and Gramme No. 7, they stand as follows:

ACTUAL OR NET EFFICIENCY OF DYNAMO MACHINES.

Weston	10-light	.85.
Siemens	5 "	.75.
Brush	16 "	.74.
"	40 "	.74.
Bürgin	3 "	.70.
Gramme	5 "	.68
Maxim	1 "	.66.
Brush	38 "	.65
Siemens	2 "	.63.
Siemens	1 "	.61.
Gramme	1 "	.60.

These figures are extremely instructive, and will, we think, bear much study. The efficiency of the Weston machine appears to be very much higher than that of any other on the list. This, as will be seen, is due to the fact that not only is the gross efficiency extremely high, but the co-efficient of electrical efficiency is also extremely high. We think it proper to state, that the Weston machine before the committee had the field magnet coils included in the main circuit, and that it is claimed that the Weston machines, of the present type, having the field coils in derived circuit, have a much higher co-efficient of electrical efficiency. This is also true of the Siemens machines.

The Bürgin machine, which appears to have an equal gross efficiency, falls far below the Weston, and other machines on the list, in actual efficiency, on account of its low co-efficient of electrical efficiency, while the Brush machine, which stands at the foot of the list as regards gross efficiency, occupies a respectable position with regard to actual efficiency, on account of its high co-efficient of electrical efficiency.

The co-efficient of electrical efficiency indicates, properly speaking, a more or less effective disposition of the armature and field coils for developing electro-motive force. It would, obviously, be extremely desirable to have no internal resistance whatever in a dynamo machine, as all internal resistance involves, not only absolute waste of energy, but injurious heating of the machine; but this, of course, is impossible. A certain number of convolutions, in the field coils, are necessary for exciting the field magnets, and, in order to secure sufficient length of conductor moving in the magnetic field, to develop the requisite electro-motive force for working the external circuit, there must be a considerable number of convolutions in the armature coils. In both the Weston and the Brush machines, the part of the circuit included in the field coils and the armature, appears to have been arranged in an extremely efficient manner for developing the electro-motive force required, while the other machines appear to be far inferior to them in this respect.

The comparatively low actual efficiency of the Brush machine appears to be due, almost entirely, to its extremely low gross efficiency. This is very suggestive, in view of the fact that the Brush machine differs radically from all the other machines before the committee, with respect to the connection of the armature coils with the commutator. In the Brush machine the armature coils are not always in circuit, but each armature coil is, during a part of the revolution of the armature, cut-out of the working circuit and open circuited; while in the other machines the coils are connected in closed circuit in endless series, and are all constantly in circuit. The results obtained by the committee appear to demonstrate conclusively, that this peculiarity of construction of the Brush machine is a radical fault of design, and involves very great waste of energy. The difference in gross efficiency between the two types of machines appears to be so great, that unless compensating advantages of unmistakable value, are secured by the open circuit system of connection with the commutator, machines of this type must, in the long run, labor under a serious disadvantage in competing with machines of the closed circuit type.

It has been claimed, that by cutting out the armature coils during the part of the revolution of the armature when they are comparatively inactive, useless resistance is eliminated from the internal circuit of the machine and a higher co-efficient of electrical efficency is obtained, than is obtainable with the closed circuit or endless series connection. A comparison of the Brush machine with the Weston, however, does not warrant this claim, as the co-efficient of the Weston machine is somewhat higher than the average co-efficient of the three Brush machines; and, as we have already said, we are informed, that this co-efficient has been very greatly increased in the new type of Weston and Siemens machines, having the field coils in derived circuit. Curiously enough, with the commutator connections used in the Brush machine, cutting out armature coils actually increases the internal resistance of the machine instead of diminishing it, as the armature coils are connected with the main circuit in multiple arc instead of in series.

It has also been claimed, with considerable confidence, that machines of the closed circuit type cannot be made to develop as high an electro-motive force as is obtained with machines of the other type. We see no theoretical foundation for such an assumption, but believe, that on the contrary, machines of the closed circuit type will be found more efficient in this respect also. Obviously, other things being equal, higher electro-motive force is developed by all the armature coils, acting in conjunction, than by a part of them, and we can see no advantages to be gained, in respect of electro-motive force, by cutting out a part of the armature coils from the circuit, even when they are not in the strongest part of the field.

Referring now to line 19 of the table, "percentage of applied power appearing in the arcs," the figures given, indicate the proportional part of the entire mechanical energy expended, which appears as useful work in the arcs. In these figures the resistance of the entire system has to be taken into account; the resistance of the generator, the resistance of the circuit wires, and the resistance of the lamps themselves. As we have already said, the results would have been more instructive, had the different machines and lamps been used under the same conditions—that is, with the circuit wires forming the same proportional part of the entire external resistance. In line 29 of the table, we have calculated the percentage of external resistance represented by the circuit wires, taking the different systems as they were used by the committee, and we find that it varies from one per cent. in the case of experiment No. 12, to 18 per cent. in experiment No. 6, (leaving out of account the Jurgensen machine, which, as we have said, was used under entirely abnormal conditions); that is, the Brush 40-light machine in experiment No. 12, was used under the most favorable conditions of all, while the Bürgin machine was used under the least favorable. Without, however, taking these differences into account, the results shown in the table stand as follows:

PERCENTAGE OF APPLIED POWER APPEARING AS USEFUL WORK IN THE ARCS.

Weston	10–light	.77.
Brush	40 "	.73.
"	16 "	.72.
Gramme	5 "	.65.
Siemens	5 "	.63.
Brush	38 "	.62.
Siemens	2 "	.60.
Bürgin	3 "	.58.
Maxim	1 "	.57.
Siemens	1 "	.57.
Gramme	1 "	.43.

Referring now to line 20, "percentage of total electrical energy appearing in the arcs," the efficiency of the machine is eilminated, and the figures given, indicate merely the relative resistance of the lamps to the resistance of the rest of the circuit, including the internal resistance of the machine, and the resistance of the circuit wires. In this, owing to the relatively low resistance of the circuit wires, the Brush stands at the head, and the different systems are arranged in the following order:

Brush.	40–light	.87.
"	38 "	.85.
"	16 "	.84.
Weston.	10 "	.80.
Gramme	5 "	.76.
Siemens	5 "	.67.
"	1 "	.66.
"	2 "	.65.
Maxim	1 "	.62.
Bürgin	3 "	.61.
Gramme	1 "	.53.

By reference to the preceding line, however, it will be seen that although the resistance of the circuit wires used with the Weston machine was ten per cent. of the entire external resistance, and the resistance of the mains used with the Brush machine, in experiment No. 12, was only one per cent., yet, the actual efficiency of the entire system was considerably higher in the case of Weston, on account of the greater efficiency of the generator.

Line 20 is principally useful, as showing the great desirability of keeping down, as far as possible, the relative resistance of the mains; and it is obvious, that those systems working a comparatively long arc, and in which the resistance of the lamps is consequently relatively high, have the advantage of involving less waste of current energy in the mains with a given size of conductor. In this connection, we may properly consider line 24, which shows the number of carcels per ampère of current. This, as will be seen, has no discoverable relation to the efficiency, either of the machines or lamps, but appears to depend principally upon the comparative length of the arc used. It varies from 8.85 in Gramme 1-light, to 3.70 in Weston 10-light. We regret that the report does not give the length of arc used in each lamp.

Line 21, "carcels per horse-power applied to generator," probably contains the information most interesting to the public generally, as it shows the comparative results in light, produced for each horse-power expended in driving the machine. The systems, arranged in the order of their efficiency, stand as follows:

CARCELS PER HORSE-POWER APPLIED.

Siemens	2–light	77.2.
"	1 "	68.9.
Weston	10 "	65.3.
Gramme	5 "	63 8.
"	1 "	60.
Maxim	1 "	58.7.
Brush	40 "	52.1.
Siemens	5 "	51.5.
Bürgin	3 "	46.2.
Brush	16 "	45.4.
"	38 "	44.4.

These results are not strictly comparable with each other, on account of the differences in relative resistances of the mains used, to which we have already alluded, and on account of the great difference in the amount of light given by each lamp in the different systems. If, for instance, the mains used, had in each case been made equivalent in resistance, to one per cent. of the total external resistance, as in the case of the Brush 40-light, the results obtained with the other systems would have been considerably increased.

We do not consider these results as indicating an absolute measure of value of the systems, as it is obvious, that the Siemens machines for producing one or two lights of the large size used in the experiments, would not be capable of the wide industrial application, which the Brush and Weston systems have received.

Line 22, "carcels per horse-power of electrical energy," does not vary greatly in its relative results from the preceding line. It is noticeable, however, that here the relative resistance of the mains plays a more important part.

In line 23, "carcels per horse-power of energy appearing in the arc," the efficiency of the generator, and the resistance of the mains, are both eliminated, and the figures indicate the relative efficiency of the lamps, as instruments, for converting current energy into light. Here Gramme No. 1 should be disregarded, the lamp used was regulated by hand, while Jurgensen and Gramme No. 7 should properly be included, as defects in the generator do not affect the result. It is stated that a Serrin lamp was used with the Jurgensen machine, and Crompton lamps with the Bürgin machine.

Arranging the lamps in the order of their apparent efficiency, they stand as follows:

RELATIVE EFFICIENCY OF LAMPS.

	Number of lamps.	*Carcels in each lamp.*	*Carcels per arc horse-power.*
Siemens	2	205	129.3
Gramme,	3	167	121.6
Siemens	1	306	121 4
Maxim	1	239	103.5
Serrin	1	688	98.7
Gramme	5	102	98.1
Weston	10	85	85.0
Siemens	5	52	81.3
Crompton	3	82	79.9
Brush	40	39	71.7
"	38	39	71.4
"	16	38	63.3

This cannot, properly, be regarded as an accurate comparison of efficiency of the different lamps, since, as the committee point out in their report, the amount of light produced by a given expenditure of power, undoubtedly increases, very considerably, with the amount of light produced in each lamp. Nor, would it be fair to compare single lamps with lamps constructed for working in series.

We have already spoken of the extremely low photometric results reached by the committee. Taking the value of the carcel as 9.5 candles, it will be observed that, with the principal series systems, no results were obtained as high as 1000 candles per horse-power, and, even at the maximum illuminating power which was obtained by throwing the carbons out of line, and taking the measurements on the maximum side, none of the lamps show an illuminating power of 2000 candles each.

SERIES SYSTEMS.

Candles, per lamp and candles per horse-power.

	Number of lamps.	*Maximum each lamp.*	*Mean each lamp.*	*Candles per horse-power.*
Weston	10	1463.	807.5	620.35
Gramme	5	1748.	969.	606.10
Brush	40	741.	370.5	494.95
Siemens	5	684.	494.	489.25
Brush	16	722.	361.	431.30
"	38	741.	370.5	421.80

The results obtained by Professors Ayrton and Perry, are very much higher—as will be seen by the following table, which we reproduce from the *Engineer*, omitting such parts as do not relate to arc lamps.

AYRTON & PERRY'S EXPERIMENTS WITH ARC LAMPS.

Name.	*Electro-motive force in volts between the two terminals of lamp.*	*Current in Ampère's flowing through lamp.*	*Horse-power expended in the lamp.*	*Candle Power.*		*Candles per horse-power.*		*Mean candles per horse-power.*
				Green.	*Red.*	*Green.*	*Red.*	
Crompton	37.7	25	1.26	2916	1849	2314	1467	1890
Pilsen	36.8	10·33	0.48	780	512	1625	1066	1345
Brush	38	10	0.51	2025	961	3970	1884	2427
Santier-Lemonnier. One lamp on "A" Gramme machine.	40	43	2.3	15376	5625	6685	5446	4565
Ditto.	45	42	2.54	15376	9025	6054	3553	4803
Santier-Lemonnier. One of ten lamps on H. Gramme Machine	40	12.5	0.67	540	310	806	463	634
Ditto.	40	12.5	0.67	*784	125	1170	187	678
Gravier	46.6	9.2	0.58	1023	349	1173	604	1189
Serrin	31.1	35.8	1.49	2448	938	1616	630	1123
Cance	51.8	16.7	1.16	3445	1156	2970	997	1983
Weston	33.7	21.7	0.98	2063	1024	2717	1045	1881

It should be borne in mind, that Professors Ayrton and Perry made no measurements, or tests, of the generator used in producing the current, but confined their attention to the lamp taken by itself. What they have published is, in no sense, an official report, but is in the form of a paper contributed to our contemporary *The Engineer*. Its authors do not appear to have been afforded such facilities as would be essential for thorough work, and they do not appear to be satisfied themselves with the results obtained. They say: "When measuring the strength of the lights at Paris, we were not able to extend our experiments on each lamp over a sufficient length of time to obtain an average result, independent of fluctuations of the light, due to the adjustment of the lamp not being the best for the particular strength of current passing through it * * * * * Finally, therefore, we may conclude, that to measure the efficiency of any special electric lamp, or number of candles it can give per horse-power, expended in it, requires that a very considerable number of experiments should be made on that one lamp, burning apparently under constant conditions, in order to eliminate atmospheric absorption and irregularities of burning, which are not accompanied by variations in the amount of horse-power spent in the lamp."

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* This measurement of light was made on Rumford's method.

The evident inconsistencies of the results obtained, would seem to justify the lack of confidence expressed by Profs. Ayrton and Perry in the accuracy of their work. These inconsistencies are, we are confident, entirely due to lack of facilities for making proper tests, as they are certainly not in any degree due to lack of ability on the part of the observers; and the part of their paper relating to experiments made with incandescent lamps, at London, appears to contain much valuable information.

Our contemporary, *The Telegraphic Journal*, has very justly pointed out various striking inconsistencies in the results obtained, at Paris, with arc lamps. As, for instance, referring to the performances of the Brush and Pilsen lamps,—"measurement between the terminals of these two lamps gave the following results:—electro-motive force in volts: Brush 38, Pilsen 37; current in ampères flowing through the lamp: Brush 10, Pilsen 10.3; horse-power expended in lamp: Brush .51, Pilsen .48. It will be seen that for all practicable purposes the electrical conditions of the two systems were identical, and of course the resistance between terminals must have been practically the same, and one would expect that the lights produced would also be equal; but we are told that observations, through a green glass, gave, Brush 2,025 candles, the Pilsen only 780; through a red glass, Brush 961 candles, the Pilsen 512; and that the candles per horse-power expended in the lamps = Brush, observed through green glass, 3,970 candles, through red glass, 1,884, the mean result being 2,427 candles; whilst the Pilsen lamp gave, when observations were taken through green glass, 1,625 candles, through red, 1,066, the mean result being 1,345 candles, or a little more than half that of Brush. * * * * Take another instance, the Crompton system; we are not aware that this lamp has any considerable resistance, independent of that in the arc itself, to absorb any large part of the current passing, yet, with the same electro-motive force as the two before mentioned lamps, and a current of 25 ampères flowing, 2½ times more quantity than either the Brush or Pilsen, and absorbing 1.26 horse-power in the lamp, we only get a candle power per horse-power of 1890, or about three quarters that of Brush.

"A still more astonishing result is shown in measuring the Sautier-Lemonnier lamp, the electro-motive force is given as 40 volts (a trifle more than was shown in the Brush), the current in ampères 12.5, the above remark applying to this also, and the horse-power absorbed in the lamp .67, yet this lamp only gives a mean result for horse-power of 634 candles."

Other similar inconsistencies occur in the table, and these we must attribute either to defects in the instruments or errors in the observations, or to a difference in the adjustment or condition of the lamp when the measurement of the light was made. It is obvious, for instance, that if the carbons in two lamps were out of line so as to turn the greater part of the light in one direction, and the photometric observation was made in one case on the maximum side, and in the other on the minimum side, the apparent difference would be very great, while the mean difference might be extremely small. We think that the figures given cannot safely be taken, even as a basis of comparison of the different lamps, but we must consider them as entirely misleading, except perhaps, as showing that the photometric observations of the Paris committee were, as a whole, quite low.

This is also indicated by the following table which is taken from the Proceedings of the Naval Institute, of April 14, 1882, and shows the results of experiments made at the U. S. Torpedo Station, at Newport, with Brush and Weston machines:

EXPERIMENTS MADE AT THE U. S. TORPEDO STATION, NEWPORT, WITH BRUSH AND WESTON MACHINES.

Weston 10 light machine.								Brush No. 5 machine wound for 3 lights.				
9.781	9.945	10.83	9.48	9.56	9.50	6.8	6.506	5.52	4.95	4.87	4.96	*Horse-power applied to generator.*
925	935	935	930	920	930	700	690	650	615	615	635	*Revolutions.*
17.98	18.27	19.39	17.65	17.73	18.41	18.61	18.45	23.25	23.72	24.31	25.80	*Ampères.*
2.15	2.15	2.15	2.13	2.13	2.15	2.13	2.11	1.35	1.35	1.35	1.35	*Internal Resistance.*
15.00	14.76	13.70	14.67	14.53	13.51	8.39	8.30 (all arcs.)	1.48	1.56	1.50	1.57	*Resistance of 1 arc.*
10	9	8	10	9	8	7	7	2	2	2	2	*No. of arcs.*
18.45	18.13	16.99	18.10	17.88	16.80	11.58	11.49	4.90	5.06	4.74	4.86	*Total Resistance.*
7.958	8.112	8.567	7.557	7.54	7.633	5.872	5.243	3.55	3.81	3.75	4.34	*Horse-power in circuit.*
6.450	6.504	6.900	6.124	6.138	6.188	3.89	3.786	2.15	2.35	2.38	2.80	*Horse-power in arcs.*
1217	1796	2100	1935	1710	1995	1700	1548	2059	2186	2216	2213	*Candles in 1 arc.*
1244	1625	1626	1900	1610	1600	1750	1642	746	883	910	802	*Candles per horse-power applied.*
								1915	1860	1863	1580	*Candles per horse-power in arcs.*
81.4	81.5	82.9	79.7	78.9	79.6	79.0	79.5	64.3	77.0	77.0	87.4	*Gross efficiency* $\frac{\text{H. P. in circuit}}{\text{H. P. applied.}}$
66.0	66.3	66.8	64.6	64.2	64.0	57.2	57.4	39.	47.5	43.9	56.5	*Net efficiency* $\frac{\text{H. P. in arcs}}{\text{H. P. applied.}}$

It is to be regretted that more complete data are not given, and the comparison would have been more satisfactory if a Brush machine of larger size had been used.

The measurements of light, it will be observed, are very much higher than those of the Paris committee, while the measurements of power applied to the Weston machine are considerably lower.

With such methods, as are at present available for measuring power and light, great discrepancies between the results obtained by different observers seem to be unavoidable; and the only way in which we can hope to obtain a fair comparison of the different systems is to submit them to the same observers, and have the different measurements taken as nearly as possible under the same conditions and with the same instruments. Much progress has been made since the Paris Exposition; and it would be of great advantage to all interested in the development of the electric light, if the principal systems, now before the public, could be submitted to an exhaustive series of tests, in the way we have indicated, by competent scientific men, who would command the confidence both of the manufacturers and of the users of the apparatus. We hope that the different electric light companies will see that it is for their advantage to institute such a series of tests at an early day.

—— THE OLD ARM CHAIR is what they sing about, but for business, give us the new arm chair, the latest invention for tame bores. It is so arranged, that when it is considered that our chronic office visitor has sat long enough, a foot switch, in another part of the room, can throw currents to various parts of the chair, at harmless looking upholstery buttons and gimp tacks, so that the twinges which our friend receives will incline him to the belief that he had better go home, before he is too sick to be carried there. For extreme cases a battery of Leyden jars can be provided.

THE INVENTOR A FACTOR OF CIVILIZATION.

ONE of the features of modern civilization is expressed in the desires of each individual, to an extent far beyond the limit of his physical powers, to furnish those requirements: a greater amount of work, than the combined efforts of the workers in the community being necessary to fulfil our demands for support, and also the desires for accumulation, which is but another expression of the instinct of self-preservation.

The wants of the barbarian are supplied by occasional efforts, his labor is irregular and subsistence meagre; with the rising scale of civilization, the amount of labor, essential to a comfortable existence, increases in a corresponding manner. To satisfy the demands of the more highly civilized communities, the elements are made tributary to man; conquering nature with the forces which itself furnishes.

In commercial affairs, the capitalist and the manager are weak indeed, unless seconded by the inventor to complete the trinity of affairs. The creations of the inventor are acceptable only to the extent that they fill a demand, although it is true that at this day, a demand is frequently developed by skilful business management.

Many of the properties of steam were known before the Christian era, and the modern type of steam engine dates from Newcomen in 1705; yet, it was over half a century later, when the requirement for pumps, equal to the problem of the increasing depth of the English mines, gave ample scope to the mind of James Watt. Born a century earlier, Watt might have been an excellent instrument maker; had fate deprived the earth of his presence until a century later, there would have been opportunities for his resources in other directions; but the steam engine would already have been developed at the time when it was essential to the world's progress.

In our day, the problem of steam navigation has shown a remarkable development. Higher steam pressures, and increased engine speed, have reduced weight of machinery, and consumption of fuel, with its additional economy of diminished space; and also the changes in the ship's lines, have resulted in such economy that every pound of coal now conveys thirty-five times as much cargo across the Atlantic, as in the earlier days of the steam lines.

Everywhere, in demanding an increase in the amount of work, civilization requires that expenses should be relatively dimished. The railway statistics prove, by the logic of figures, that the increase in traffic, necessary to meet the requirements of inland commerce, have been accompanied by a modification in rates. This has been possible by the work of invention in every part of the railway system.

Stephenson's work on the locomotive was possible, only because cheaper and more rapid transportation of passengers and merchandise were of great importance. The demand for economy of time, rendered the telegraph and telephone commercial possibilities, and they in turn have readjusted systems of finance and methods of business. Electricity has its uses in every transaction and place in civilized life.

In the applied sciences, connected with all instruments of precision, electricity is essential to obtain the most correct results. The indications of the weather, and the uniform distribution of correct time, are examples of its use in popular science. The watchmen's clock supplies the faithful guardian of property with an unimpeachable record of duty performed. The dials of some of these ever vigilant devices, bear the motto: *custos ipsos custodios*, an expression which, like law, bears hard only upon offenders.

In some lines of manufacture, notably electro-plating, electricity has superseded other methods and processes. The results with electric lights in mills, have been so favorable that it may be considered essential to the best results in manufacturing during night work.

In the fire alarm, electricity forms a stalwart defender against the ravages of fire, its timely warnings summon the fire department with such promptness, that builders rear their piles of combustible construction in defiance of the chances of conflagration.

In our homes, the simplest electrical devices form conveniences which add much to comfort. Let us recount a few of these contrivances which are regularly made for the market, and not merely the toys of ingenious youth. The foot fall on the door mat, or the porch step, announces an arrival before the comer can touch the electric door bell. Servants are called at will with annunciators, or in combination with a clock, summoned at pre-determined times.

A pull on a tassel hanging from the chandelier, lights the gas, to the exclusion of the baneful friction match.

When the temperature departs from a selected range, a ringing bell gives notice of the fact. When the burglar begins his trespass, it sounds an alarm for the household and the police, and also turns on and lights the gas, to the discomfiture of those "who prefer darkness rather than light, because their deeds are evil."

The mechanical problem of the coming age, will be to accomplish the economical transfer, concentration, and possibly, storage of energy. The first two are essential, and the third is of great and perhaps equal importance. The limits of the use of steam are so well defined that it is probable that either electricity, or fuel gas will be the means by which small powers can be produced, with an economy approaching that of large centres of power. Practical difficulties still surround the gas engine, and the electro-motor, especially in matters relating to accuracy, and economy in regulating speed, although gas engines are quite successful in some places, even when supplied by the more expensive illuminating gas. We anticipate that the gas engine will, eventually, prove one of the most efficient allies to the electric lighting interests.

In citing a few of the many instances of the uses, and expectations of electricity, we wish to call attention to the increasing extent of the field for the employment of electricity; as it furnishes a principle which is a guardian that never sleeps, a messenger that never wearies, a light that vies with the noon-day sun, and embodies the most economical method of transmitting power.

The civilization of to-day, looks to the inventor for perfecting many an immature device, as well as for solving the problems which beset the path of improvement.

ATTENTION was called in these columns, some time ago, to the very satisfactory dividends, paid by the solid and enterprising electric companies, in England. We are glad to see that such companies are also proving very remunerative, in this country.

While some undertakings without any solid basis, financial or industrial, will assuredly come to grief, there is no doubt that electricity will continue to afford an almost limitless field for capital, and a paying investment for many years to come. It has some peculiar advantages: The most rapid transmitter of human thought; it can be used for automatic purposes to a magic extent; annihilating space; marking time to the second. It is also a transmitter of force, and will be used as the great distributor of power, in ways that are not dreamed of yet. It is also the illuminating agent of the future. It is, finally, susceptible of developments, and services, which are, as yet, in the womb of time. Capital has not turned to it yet, as much as was expected, but the probabilities are, that it will soon be largely attracted by it.

PATENTS FOR DECEMBER, 1882, AND JANUARY, 1883.

DECEMBER 26th.

269,559 Electric Current Meter. A. Bernstein, Boston, Mass.
269,605 Electric Machine, Dynamo. E. Thomson, New Britain, Conn.
269,761 Electric Machine, Dynamo. E. Weston, Newark, N. J.
269,805 Electric Machine Regulator, Dynamo. H. S. Maxim, Paris, France.
269,606 Electric Machine Regulator, Dynamo. E. Thomson, New Britain, Conn.
269,593 Electric Safety Apparatus for theatres, and other buildings. C. A. Mayrhofer, Vienna, Austria-Hungary.
269,568 Electrical Conductors, Conduit for. W. B. Eltonhead, Philadelphia, Pa.
269,807 Insulating Wires. L. H. McCullough, Richmond, Ind.
269,759 Lamp, Electric Incandescent. E. Weston, Newark, N. J.
269,757 Lamp Holder, Incandescent Electric. E. Weston, Newark, N. J.
269,526 Lamps, Apparatus for Suspending, Raising, and Lowering Electric. C. C. Jennings, Buffalo, N. Y.
269,758 Lamps, Suspending and Circuit Controlling Mechanism for Arc. E. Weston, Newark, N. J.
269,794 Medical Induction Coil, Electro. J. Kidder, New York, N. Y.
269,735 Telegraph and Telephone Cable. J. Speicher, New York, N. Y,
269,634 Telegraph Printing. W. J. Burnside, Hilcot Court Road, Lower Norwood, County of Surrey, England.
269,521 Telegraph Transmitter, Electric. E. M. Hamilton, New York, N. Y.
269,657 Telephone, Speaking. G. A. Fitch, Oakland, N. Y.
269,760 Rheostat. E. Weston, Newark, N. J.

JANUARY 2nd.

270,125 Time Detector, Watchman's Electric. J. E. Richards, Cedar Keys, Fla.
270,058 Time Pieces, Electric Synchronizing Apparatus for. J. Hamblet, Brooklyn, N. Y.
270,186 Vehicle, Electric. J. R. Finney, Pittsburg, Pa.
269,860 Annunciator, Oral. J. Ireland, Cleveland, Ohio.
269,862 Burglar Alarm, Electric. C. T. Jackson, New York, N. Y.
2'0,017 Electric Machine, Dynamo. A. Chertemps, and L. Dauden, Paris, France.
269,888 Electric Motor. W. L. Silvey, Castleton, Ind.
269,868 Electric Wire Cable. J. Mackintosh, Philadelphia, Pa.
269,933 Insulator for the Suspension of Electrical Wire Conductors. P. Higgs and W. Courtenay, New York, N. Y.
269,937 Lamp, Electric. C. A. Hussey, New York, N. Y.
269,938 Lamp, Electric-arc, C. A. Hussey, New York, N. Y.
269,939 Lamp, Electric-arc. C. A. Hussey, New York, N. Y.
270,157 Mallet, Electric. J. R. Finney, Pittsburg, Pa.
269,879 Telephone, Electric. H. B. Porter, Chicago, Ill.
269,884 Telephone Transmitter and Receiver. J. H Rogers, Washington, D. C.
270,136 Telephonic Transmitter. G. E. Shaw, Chicago, Ill.
269,960 Thermostat, Electric. T. Reeve, Brooklyn, N. Y.

JANUARY 9th.

270,218 Car Brake, Electrical. A. S. Parsons, Huntington, W. Va.
270,533 Clocks, Electrical Control for Pendulum. R. W. Willson, New Haven, Conn.
270,478 Coupling for Wires and Electric Conductors. H. F. Pumphrey, Fairfield, Iowa.
270,438 Electric Cable. W. W, Jacques, Boston, Mass.
270,491 Electric Light. H. A. Seymour, Washington, D. C.
270,230 Electric Machine, Dynamo. J. Lewis, Chicago, Ill.
270,325 Electric Machine, Dynamo. J. J. and T. J. McTighe, Pittsburg, Pa.
270,518 Electric Machines, Apparatus for Cooling the Armatures of Dynamo. P. H. Van der Weyde, New York, N. Y.
270,352 Electrical Currents, Device for Controlling. C. J. Van Depoele, Chicago, Ill.
270,361 Lamp, Electric-arc. P. R. Allen, Victoria Works, Belvedere Road, County of Surrey, England.
27),449 Lamp, Electric-arc. S. Martin and J. F. Richards, Pittsburg, Pa.
270,379 Lightning Rod. J. H. Brandon, Chicago, Ill.
270,457 Magneto-electric Machine. A. Millar, Glasgow, Scotland.
270,200 Railway, Automatic Electric. E. N. Dickerson, Jr., and C. G. Curtis, New York, N. Y.
270,556 Telephone Exchange System. C. A. Randall, New York, N. Y.
270,326 Telephone Switch. T. J. McTighe, Pittsburg, Pa.
270,522 Telephone Switch. T. A. Watson, Everett, Mass.
270,500 Telephonic Circuit. J. M. Stearns, Jr., Brooklyn, N. Y.
270,551 Voltaic Battery, Portable. J. Mackenzie, Osnaburgh St., County of Middlesex, England.

JANUARY 16th.

270,639 Clock, Electric Alarm. J. I. Conklin, Jr., New York, N. Y.
270,778 Electric Battery, Secondary. W. K. Freeman, Brooklyn, N. Y.
270,735 Electric Lighting for Railway Trains, System of. C. E. Buell, New Haven, Conn.
277,779 Electric Machine, Dynamo. W. P. Freeman, New York, N. Y.
270,780 Electric Machine, Dynamo. W. P. Freeman, New York, N. Y.
270,781 Electric Machines, Armature for Dynamo. W. P. Freeman, New York, N. Y.
270,777 Electric Machines or Electric Motors, Armature for Dynamo. W. K. Freeman, Brooklyn, N. Y.
270,734 Electric Storage and Supply, System of. C. E. Buell, New Haven, Conn.
270,702 Galvanic Battery. G. Scrivanow, Paris, France.
270,806 Lamp, Electric. W. F. Jobbins, East Orange, N. J.
270,725 Lamp, Electric-arc. G, W. Beardslee, Brooklyn, N. Y.
270,676 Lamp, Electric-arc. C. A. Hussey, New York, N. Y.
270,867 Railway Signaling, Electric Circuit for. G. Westinghouse, Jr., Pittsburg, Pa.
270,767 Telegraph Key. E. A. Edwards, Cincinnati, Ohio.
270,652 Telegraph Key. W. D. Farren, Boise City, Idaho.
270,848 Telegraph, Mechanical Speaking. A. M. Rosebrugh, Toronto, Ontario, Canada.
270,774 Telegraphs, Perforator for Automatic. T. M. Foote, Brooklyn. N. Y.
270,674 Telegraphic Apparatus. W. L. Hunt, Port Hope, Ontario, Canada.
270,775 Telegraphy. T. M. Foote, New York, N. Y.
270,752 Telephone Transmitter. W. A. Crawford, San Antonio, Texas.

BUSINESS ADDRESSES.

Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Burnap, W. H. Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q. Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Edson's Speed & Pressure Recording & Alarm Gauges, for "Steam Dynamo-machines," indispensable for safety & economy, office 91 Liberty St., N.Y.

Fairman, James F. Telephone, Telegraph, and Electric Light Supplies, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C. Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 114 Centre Street, New York.

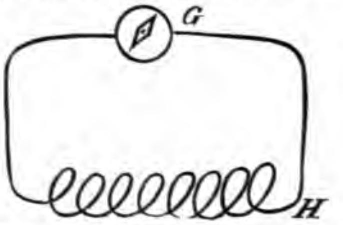
Smith & Rhodes Electric Co.
LIMITED.
T. H. RHODES' PATENTS,
MAY 31, 1881.
MAY 2, 1882.
APRIL 25, 1882.
JULY 11, 1882.
GAS LIGHTING BY ELECTRICITY.
Entirely Automatic!
Absolute Safety from Fire!
No. 37 BARCLAY STREET,
New York.

of the above described apparatus, to the study of the variation in the magnetism of iron produced by variations in the strength of the current of electricity within the coil.

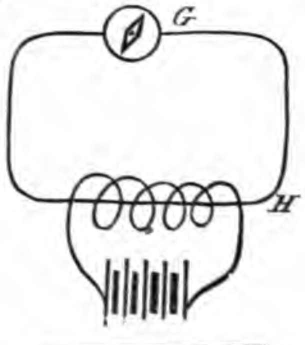
AN IMPORTANT DISCOVERY.

PROF. A. E. Dolbear, of Tuft's College, near Boston, has made an important discovery, proving that magnetism consists of a molecular change.

It is well known, if a galvanometer be placed between the terminals of a circuit of homogeneous iron wire, and heat be applied, no electrical effect will be observed ; but if the structure of the iron is altered by alternate bending, or twisting to a helix, as shown in the sketch, and heat applied at H, then the galvanometer G will indicate the presence of an electrical current in the wire.



The professor used a circuit of homogeneous iron wire, and the application of heat at H produced no electrical current in the wire. A portion of the wire was surrounded by a helix, and connected with a battery ; the current in these wires, of course, magnetized the circuit wire where it was surrounded by the helix ; under these circumstances, the galvanometer at G showed the presence of electricity in the main circuit; as it is well known, that upon the application of heat to a circuit of un-homogeneous material, a current is produced ; and this experiment showed, that a current was produced in the circuit, only when a portion was magnetized. These experiments prove, that magnetism must be connected with some molecular change of the metal magnetized.



—— ON THE 18th of January, Mr. Arthur Schofield, an aged gentleman of means, was found dead in his bed, at the St. Stephen's Hotel in this city. The room was filled with gas, the old gentleman having, turned it on, and evidently forgotten to light it.

—— IN THE SUIT OF Catharine Vincent against the city of Brooklyn for damages, for the loss of the life of her son, Oliver S. Vincent, a clerk, who was killed by a gas explosion in the vault of the Tax Office in the Municipal Building, the jury, on the 18th of January, gave her a verdict for $5,000, the full amount claimed.

—— A PATENT HAS been taken at Görlitz, Germany, for an invention which will make it difficult for burglars to escape detection. In the neighborhood of a safe an apparatus is placed, which on being touched immediately starts an electric light, and at the same time uncovers a prepared plate, on which the burglar's photograph is taken while an alarm is sounded.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(Continued from page 10.)

THE MANHATTAN INSTRUMENTS.

FOR the transmission of general news despatches, on the long up-town and surburban lines, as well as for the distribution of Kiernan's financial news to his subscribers—a service which is undertaken by this company—an instrument bearing the above name is used. It was invented by Mr. J. E. Smith, and first manufactured by the late Charles T. Chester, and was introduced by a competing company called the Manhattan Quotation Company, from whence it derives its name. After the consolidation of the Manhattan Quotation Company with the Gold and Stock Telegraph Company, the managers of the latter determined to avail themselves of the good qualities of the instrument which the fortune of war had placed in their hands ; and machines were at once put into use for the general news service, and subsequently, after their immense superiority to the machines then in use had been demonstrated, more were constructed and placed on Kiernan's *financial news* circuits. There are now in use, in New York City and suburbs, over 400 of these instruments.

In describing these machines, it will be found conducive to an easy grasp of the details, if the receiving machine should be described first, and the transmitter afterward, and that arrangement will therefore be adopted.

In studying this instrument we meet at once different principles of design and construction to those of the three wire instruments already described. This instrument has but one wire, in place of three ; all the characters of its alphabet are placed on the periphery of one single type wheel ; the letters and figures are printed in one line on the paper ; and what is the most important difference, and also the foundation of its great superiority in speed, is the fact that the motive power which drives the type wheel, is a spring or weight in the receiving instrument itself. In the three-wire machine, first described, the main line current drives the type wheel; while in this machine the current only controls the movements of an escapement anchor which releases the type wheel. As electricity is at once a subtle and costly agent, it follows that it will be cheaper and better to restrict its field of operation as much as possible. Although the introduction of machine currents on stock reporting lines, and the consequent cheaper and more abundant supply of electricity to be thereby afforded, the difference in value between the two classes of machines will be lessened, yet there will always be a margin of superiority in respect of higher speed, less wear of the parts, and greater accuracy in working, in favor of the latter class.

As has been stated, this machine was invented expressly as a competitor to the instrument first described, and it would be difficult to imagine a machine simpler, faster, more reliable, or better adapted to the work for which it was designed. It will always remain, even when superseded by the more rapid machines which increasing business demands, a monument to the inventive skill and good judgment of its inventor. The machine consists of the following parts :

First, two electro-magnets held by a frame opposite each other, having their poles in the same horizontal plane, and a polarized armature, pivoted so as to be free to vibrate between the poles of the electro-magnets. These magnets are $1\frac{1}{2}$ inches long, have a resistance of 3 ohms each, and are called the *escapement magnets*.

Second, an electro-magnet of 6 ohms resistance, and 2 inches long, acting on a neutral armature attached to a lever which operates the printing, feeding, and unison tripping mechanism. This is called the *press magnet.*

Third, a train of clock work, driven by a weight or spring, turning a shaft to which is rigidly attached the type wheel and the escape wheel. The unison is also operated by the train in a manner which will be described later. The teeth of the escape wheel engage against the pallets of an anchor, which forms the lower prolongation of the polarized escapement armature, above described. The escape wheel teeth and anchor pallets, are so shaped as to form a "dead beat" escapement; that is to say, the whole train stops and the weight ceases to fall while the wheel is held by the anchor, and starts again when that tooth is released, and so on *ad infinitum.* When the polarized armature is vibrated from side to side, by the action of the current, the escape wheel is allowed to revolve, step by step, being impelled by the weight or spring acting through the train, and in this manner the type wheel is revolved to the proper position, and held there while the operation of printing the letter takes place.

All three of the magnets, viz., the press magnet and the two escapement magnets, are in the circuit of the same line wire. The currents, therefore, pass through all three magnets simultaneously, but not in the same direction. The direction of the current through the press magnet is of no consequence, as it has a soft iron armature, but it must pass through the escapement magnets in such a way that the polarized armature will be attracted by one of the magnets at the same time that it is repelled by the other, and *vice versa,* otherwise it would not move at all. The transmitter sends into the line rapidly alternating positive and negative currents, and these in passing through the escapement magnets, vibrate the polarized escapement armature from side to side. When moved to the extreme limit of its excursion on the left hand side, the pallet of the anchor, which is attached to the armature, is moved just far enough to allow a tooth of the escape wheel to slip by it, on the right hand side, while at the same time the left hand pallet slips into the space ahead of the next tooth and locks the wheel, so that it can only move forward one tooth, or step, at a time. The reverse action takes place with a current of the opposite polarity. Now, after a sufficient number of waves of alternate polarity have been sent into the line, to rotate the type wheels to the position for printing the desired letter or figure, the last wave of current is prolonged, at the will of the operator (as long as he holds the key of the transmitter down), and the printing then takes place.

It now remains to trace out the action of these currents on the press magnet, and to explain the method by which the printing and feeding mechanism is actuated. All of the rapid waves of alternate polarity pass through the press magnet, and are all equally potent to affect its neutral soft iron armature, but the latter is provided with a powerful retractile spring, which, together with the weight of the printing lever and its accessories, constitute a load too heavy for the feeble magnetism generated by rapid waves of electricity to overcome. However, the retracting spring may be slackened so that the press magnet armature will be attracted by every pulsation passing through the press magnet, and then every letter on the type wheel will be printed in succession. The spring is made a little stiffer than is necessary to prevent this action, and then no letters are printed until the type wheel stops, and the vibrations cease, the last one being prolonged. There are three ways in which the margin of adjustment between printing every letter in succession (called technically "throwing in letters"), and printing only the desired letters when the type wheel is stopped, may be varied. First, by varying the strength of the current or the resistance in the main line; second, by varying the speed of the vibrations; and third, by varying the tension of the retractile spring or any weight on the press lever. It is obvious that the latter is the only convenient practical method. When the machines were first used, vibrating relays were arranged to cut out the escapement magnets when the type wheel stopped, thus suddenly increasing the quantity of current in the printing magnets, but the device was found to be unnecessary, and the instruments were subsequently constructed without them, as herein described.

The type wheel, which is rigidly fixed to the same shaft as the escape wheel, contains 40 characters, and is so adjusted in relation to the escape wheel, that a movement of one tooth of the latter moves the type wheel forward one letter; so that 40 emissions of the current are required to rotate the type wheel once. The type wheels usually run at the rate of 64 revolutions per minute, requiring 2,560 pulsations per minute, or 42.66 pulsations per second. A speed of 17 English words per minute, or an average of 14 stock quotations per minute, is thus attained by a skillful operator. The characters on the type wheel are especially arranged with a view to securing the printing of the name of a stock, the number of shares sold, the price and conditions of sale, all in one revolution of the type wheel; or at least, in as few revolutions as possible, and this feature is the subject of a separate patent. It is obvious that, in a step-by-step machine used for printing stock quotations, this feature will have a very marked effect upon the average speed of the machine, and in order to illustrate that point, we give herewith the characters and the order in which they appear on the wheel. A blank space, used for separating words, precedes the colon. The reader can trace for himself the consecutive letters and figures that can be used in combination, in one, or say two revolutions of the type wheel:

: VCBHPADMXRZKELNTQWUFGJSY. 1987536/42801

The printing mechanism consists of a revolving soft rubber pad, over which the paper is carried, which presses the paper against the type wheel whenever the armature of the press magnet is attracted. An adjustable limit, against which the press lever strikes, varies the force of the impact of the pad against the type wheel, and the consequent distinctness of the impression made by the types upon the paper. Fixed on the same shaft with the rotary pad is a feed wheel, with very fine teeth on its edge, and a feed ratchet, with very coarse teeth, and these three all revolve together. A pivoted hard rubber disc, called the pressure roller, is held by a projecting arm attached to the press lever, over the paper, and holds the latter down on the sharp teeth of the feed wheel, so that when the latter revolves the paper revolves with it. When the pad is moved upward, a feed dog, rigidly fixed to the frame of the machine, first slips over one of the passing teeth of the feed ratchet and then drops under it. When the press lever falls this dog retains its clutch on the tooth in the feed wheel, and it is obvious that the latter must revolve, since the former cannot move upward or downward. Another pawl, called the lower or under feed dog, which is simply a straight piece of steel spring, fastened to the frame of the machine, falls between the teeth of the feed ratchet on the opposite side to the upper dog, and catches on the flat side of the teeth, so as to prevent a backward rotation of the pad when the press lever moves upward, and the teeth of the feed ratchet are thereby rubbed against the upper feed dog, in order to push it aside to allow one tooth to pass.

The unison device and transmitting apparatus will be described in our next article.

(*To be continued.*)

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assumption, the extreme sensibility of this instrument may be thus explained.

The repulsion between the gold leaves, depends on the quantity of electricity with which they are charged. This quantity, in turn, depends upon the difference of potential between the leaves and the conductors in their neighborhood; for, if the columns or strips of tin foil are omitted, and the entire instrument insulated, but little electricity will reach the gold leaves, even from a highly charged body, and they will be, with difficulty, affected. The ordinary electroscopes are enclosed in glass, the surface of which is varied in potential, by conditions over which we have no control. Faraday has shown that the case should be metal, or the glass covered with a cage of wire gauze, the meshes of which are close enough to keep the whole surface of the glass at one potential. Then, if the columns be connected with the earth, whenever there is a difference of potential between the cap of the instrument and the earth, the leaves will freely show it.[16]

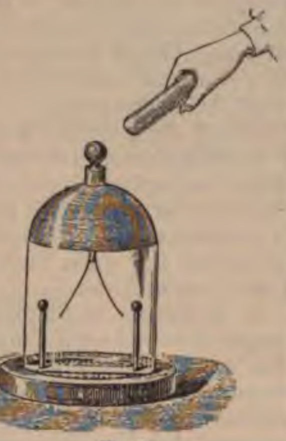
Fig. 45.

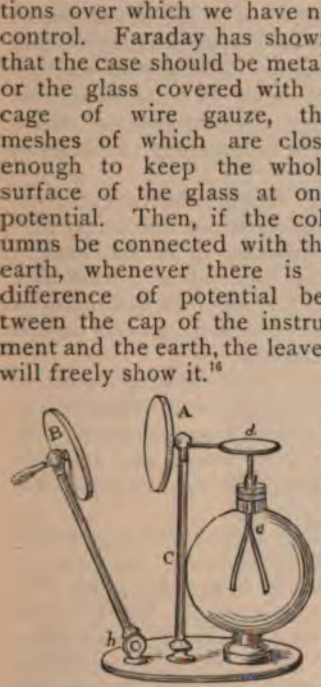

Fig. 46.

Sensitive as it is, the delicacy of Bennett's gold leaf electroscope may be increased by the combination with it of the condenser, Fig. 46, a device which augments the effect of an electrical influence communicated to it.[17]

Neither of the above instruments tells, at once, which kind of electricity is communicated to it.

Bohnenberger's electroscope, Fig. 47, which dates from the year 1820, and indicates not only a most inconceivably minute trace of free electricity, but at the same time, whether it be + or — is, therefore, by many esteemed the best. It consists of a small Zamboni pile, of about 500 pairs, supported horizontally beneath a glass shade, and connected through the bent wires *a*, *b*, adapted to its ends with two gilded parallel plates *p*, *m*, which form its poles. One of these is, therefore, always charged with + the other with — electricity, and between them hangs a strip of gold leaf *d*, *g*, which communicates with the plate *o*, *n*, through the rod *c*. Normally, the leaf is equally attracted by both poles, and hangs quiescent, but the presence and nature of the slightest trace of electricity communicated to it, is shown by its motion toward the plate which has the opposite polarity.[18]

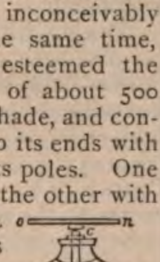

Fig. 47.

BALANCED NEEDLE ELECTROSCOPES.

Under this general title, electroscopes of the second class are included; and the earliest and simplest representative is that shown in Fig. 48, which consists, essentially, of an insulated needle, free to revolve. The needle being at rest, an electrified object brought near one of its gilded terminal discs repels it, but even though suspended by a fibre of raw silk, the necessary torsion of the fibre limits its delicacy.

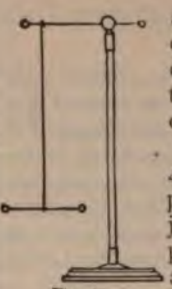
Fig. 48.

More sensitive is the modification, Fig. 49, which is constructed of a bent wire, supported on a pivot, and extended by two adjustable straws, in the ends of which, short pieces of wire, terminating in gilded discs, are inserted.[19]

Tyndall's lath balanced on an egg, is a variety of this device which suppresses the metal point.[20]

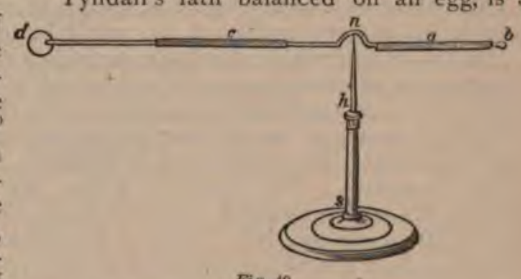

Fig. 49.

Next in order of sensibility, is the modification, Fig. 50,[21] constructed of straws, needles, and balls of pith.[21]

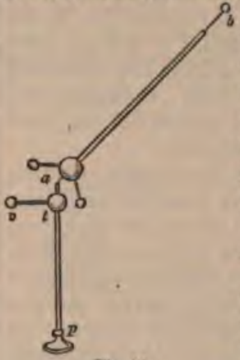

Fig. 50.

Fig. 51 presents, finally, Peltier's electroscope, the most delicate of this class,[22] which consists of a carefully poised aluminum needle, normally maintained by a magnet in the magnetic meridian, and a frame surrounding and in electrical connection with it, so placed, that when the needle is at rest, it is nearly in contact with its gilded terminal discs. From the same principles which explain the delicacy of Bennett's electroscope, it derives so great a sensibility that the least electricity applied to the frame (*c*, *d*,) will repel the needle.

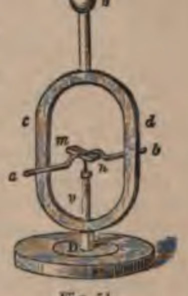

Fig. 51.

Experience indicates that electroscopes should be enclosed in cases, which may be kept dry, internally, by calcic chloride, or hydric sulphate; and may, when necessary, be dried externally by a hoop of wire, wound with cotton wool, saturated with alcohol, which, when ignited, forms a circle of flame, to be passed once or twice over the case. But a coating of atmospheric moisture, on the outside, is sometimes desirable. Needles and suspending wires may be advantageously made of aluminum, and torsion threads of spun glass.

— IN ONE OF THE course of lectures upon "The Sun and Stars," which Prof. S. P. Langley is delivering at the Lowell Institute in Boston, the speaker said that the light of the sun is two and a half times as brilliant as the same area of electric (arc) light; and that if a calcium light be held between the eye and the sun, the light would appear to be a black spot upon the sun As a measure of comparison, in assisting the comprehension of the infinite quantity of light thrown off by the sun, he remarked that if there was an electric light of 2000 candle power on each square foot of the surface of the earth, then the whole light from the earth would be less than one-billionth that from the sun. The intensity of the sun-light is one hundred and thirty thousand times that of a standard candle.

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[16] Fleming Jenkins, Elec. and Mag. N. Y. 1873.

[17] Bennett, Loc. Cit. Sir W. S. Harris, Rudimentary Elec. London, 1854. Fig. 26, p.53.

[18] Draper, J. W. Nat. Phil. N. Y. 1847. P. 297. Noad, H. M. Text Book of Elec. London, 1867. P. 73.

[19] Sir W. Snow Harris. Rudimentary Elec. London, 1854. Fig. 22, p. 49,

[20] John Tyndall. Lessons in Electricity.

[21] Sir W. S. Harris. Ibid. Fig. 25, p. 53.

[22] Fleming Jenkins. Elec. and Mag. N. Y., 1873. P. 38.

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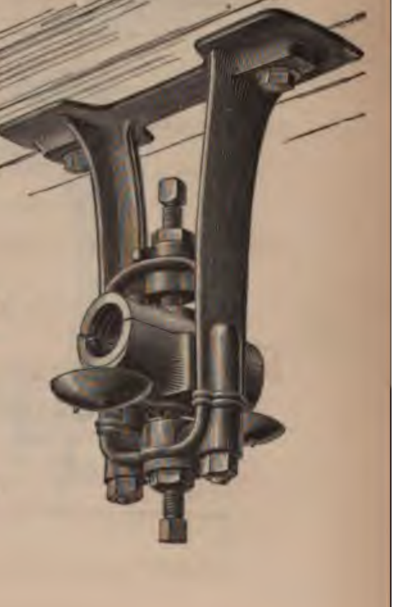
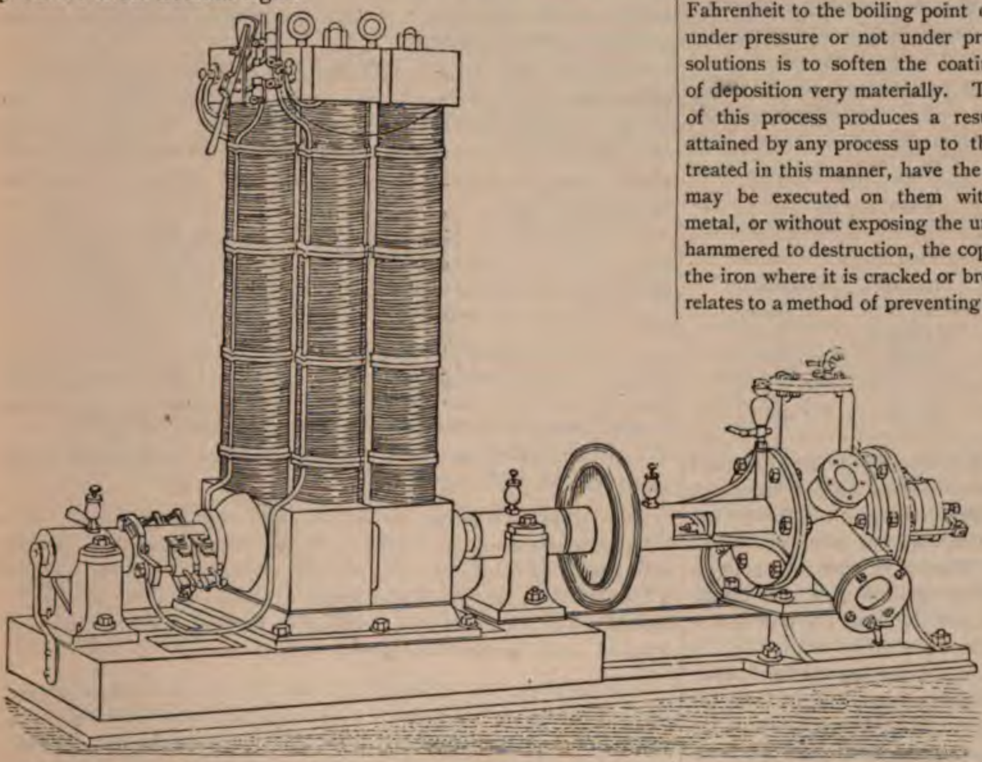


THE ELECTRIC LIGHT ON BOARD VESSELS.

THE English "Edison Electric Light Company" has recently made arrangements for lighting the two vessels: the Tarawera, and the Waihora, belonging to the New Zealand Union Steamship Company. The first vessel was built by Messrs. Denny, in their yards at Dumbarton.

The dynamo-electric machine, and the Brotherhood motor, which works it, were placed in a small room some 11 ft. x 10 ft. 10 in. x 6 ft. 3 in., adjoining the engine room. The conductors were very carefully laid, perfectly insulated wires were used, and they were protected by gutta percha and an impermeable coating of paraffined thread. Extra precautions were taken to have the current interrupted in case of over-heating. The lamps are the Edison model, of 16 candles, requiring an electro-motive power of 96 volts to produce their normal light.



The generator is an Edison dynamo, slightly modified to diminish the velocity, so that it can be worked directly by the steam motor. The following are the principal details: Resistance of armature, 0.1 ohm; resistance of each element of the magnetic field, 20 ohms; speed, 475 revolutions per minute; electro-motive power, 96 volts; current, 120 ampères; length of armature, 63 inches; diameter of armature, 125 millimetres; number of lamps supplied, 150, of 16 candles each; resistance of the heated lamps, 125 ohms.

The three cylinder motor which is used, has cylinders of 175 millimetres in diameter, with a run of 112 millimetres, and develops a maximum power of 20 horses. Both the motor and the electrical machine are mounted on the same foundation slab, which is firmly screwed down on a teak flooring, 75 millimetres in thickness. The annexed drawing gives a general view of the arrangement adopted.

The experiments were perfectly satisfactory. The machine worked with the greatest regularity, and without any periodical variations of intensity, that are sometimes so difficult to avoid. Electric lighting is one of the improvements that passengers most appreciate during a long voyage, and its general introduction on vessels, is now imperative.—*L'Electricien.*

IMPROVEMENTS IN ELECTRO-DEPOSITION OF BRASS AND BRONZE

WE learn, from a foreign cotemporary, that some improvements in the electro-deposition of brass, bronze, and other metals, have been recently patented by W. H. Walenn, of England. The absolute adhesion of the coating to the metal, together with constancy of the solution and softness and ductility of the deposited metal, are the results of the methods used. The first part of the invention relates to electro-depositing copper upon iron and similar metals, so that the coating may be adherent and in a soft condition. Preferably, the solution used is compounded of thirty-two ounces avoirdupois of cyanide of potassium (70 per cent. real cyanide) and one ounce of neutral tartrate of ammonium per gallon of liquid, and it is charged with copper by electrolytic means; the solution is then made complete by the addition of cupric ammonide. The solution is used at a boiling heat, or near thereto, namely, from 150° Fahrenheit to the boiling point of the solution, whether the solution be under pressure or not under pressure. The effect of heat upon these solutions is to soften the coating of copper, and to increase the rate of deposition very materially. The following example of the application of this process produces a result, which, it is stated, has never been attained by any process up to the present time. Thin sheet iron plates, treated in this manner, have the coating so adherent, that repoussé work may be executed on them without interfering with the continuity of metal, or without exposing the underneath or coated metal. If a plate be hammered to destruction, the copper coating will be simply extended over the iron where it is cracked or broken. The second part of the invention relates to a method of preventing the too great evaporation of a solution which is heated during deposition. The conducting wires, from the source of electricity, are passed through the depositing tank, but are insulated therefrom, and all rods or wires for suspending anodes or cathodes, have their bearings upon inside shelves, mounted with slabs of non-conducting material. Over the whole, and dipping into a water seal, is a counterbalanced cover, that is removable by means of pulleys and slinging chains. To an aperture in the cover, is adjusted a long condensing worm tube, opening into an upper vessel or box, that contains materials which are capable of condensing, or absorbing or combining with the gases that escape. The liquids flow back down the tube into the tank. This improvement applies to cyanide coppering, brassing and bronzing solutions, to gilding solutions, and to all electro-depositing solutions that are heated. The third part of the invention relates to working copper, brass, bronze, gold, and other electro-depositing solutions, in a closed vessel under a known pressure, the pressure being applied by heating the solution or otherwise. This plan has the great advantage of preserving the purity and stability of the solution, and of preventing its waste by evaporation; it enables the electro-deposit to be uniform over the surface of the cathode, and to be of compact and uniform quality throughout. A high pressure is not recommended; a single atmosphere is in general, more than sufficient. The closed vessel may be used for solutions in which there is free ammonia, or where it is essential to keep the solution free from dust, or where other conditions arise in which it is necessary to inclose the solution, although neither appreciable increase of pressure arises, nor is heat applied. If there be much gas or vapor coming off, the condensing worm tube opening into a vessel may be employed. Another improvement consists in adding to the charged and finished solution in the cold cupric ammonide, until the solution is slightly green in color. In a solution treated in this manner, it is exceedingly difficult to isolate the combination containing ammonia, so as to obtain its formula; but, from the constancy, persistency, and stability of a solution treated with cupric ammonide, as above described, it seems most probable that a definite ammoniacal salt is formed, which is not decomposable (or is difficult of decomposition) at a high temperature.

THE LARGEST ELECTRO-MAGNET.

THE largest electro-magnet in the world, according to the German *Humboldt*, is that in the physical institute of the Greifswald University. It is made of 28 plates of iron, each 7 millimetres (about ¼ in.) thick. A massive iron core was not permissible, owing to the cost and other difficulties. These plates were so cut that their width corresponded to the consecutive parallel chords of a circle seven times 28 mm. (20 in.) in diameter. They were heated in a fire, and bent to a horseshoe form The sides that were to be opposite each other, were varnished or lacquered, to make the action of the extra current as great as possible, and then they were fastened together. The projecting edges were then filed off smooth. In this way a horseshoe magnet was obtained that is 1,270 mm. (51 in.) high. The diameter of the cylindrical core is about 8 in., and its total length 9 ft. The distance of the poles from the centre of the cylinder is 24 in., and the weight of the core 1,381½ lb. The magnetizing coil is partially of copper ribbon, and partially of copper wire. The strips of copper are in rings of 15 windings each, separated from each other by strips of gutta percha, and soldered together to form a continuous-current. The copper wire is put around it up and down, two and two, with thick paper between the layers. There are five double layers of two wires each, so that with the copper ribbon there are 25 courses, one over the other, the weight of them being 605 lb. Total weight of core and coil, 1,986½ lb.

For comparison we give the size of other large horseshoe electro-magnets:

	Faraday's.	Pluecker's.	Greifswald.
Length of core	46½ in.	53 in.	108 in.
Diameter of core.	40 in.	40½ in.	80 in
Weight of core	142½ lb.	185 lb.	1,381 lb.
Distance of poles	6.0 in.	11.4 in.	24.0 in.
Number of layers of wire..	3	3	25
Total weight.	187 lb.	262 lb.	1,986 lb.

The iron core is cemented in a box made of stout oaken plank, and resting on wheels. The current is generated by 54 Grove-Poggendorff cells. With this powerful instrument a great variety of experiments can be performed. When a copper cylinder, containing 40 grams of Wood's fusible metal (melting at 65° or 70° C.), is rotated between the poles, it melts in less than two minutes. A rotating copper disc, 10 in. in diameter, which can be rotated rapidly in a vertical plane by means of a weight, is almost stopped on closing the current. The rotation of the plane of polarization in Faraday's flint glass is seen when the light passes through it only once. By using a sugar solution in a tube 8 in. long, the plane of polarization changes from red to light blue on reversing the poles. The magnetic action on liquids, gases, and flames can be made visible to a large audience.

—— SOME ELECTRIC APPARATUS connected with the watchmens' clock in a mill did not operate satisfactory at times, and an examination showed that there was an "escape" of electricity, while the machinery of the mill was in operation, but there was no such indication at tests made at night or during the noon hour. It was finally decided by the electrician in charge of the matter, that the sparks of static electricity from the belts formed conductors from the wires to the ground, and it is stated that the difficulty was removed by changing the position of wires from proximity to belts. While we are not in a position to deny that a succession of sparks could be the source of the difficulty, it is more probable that the motion of the machinery, moved some conductor against the electric wires. We recall a similar instance, where one of the wires of an electric light circuit in a mill, was swayed against a water-pipe, by the jar of the mill when the machinery was in motion, but it hung away from the pipe when the machinery was not in operation. As in the first instance, tests made outside of working hours, showed that the line was clear, and then when the dynamo was in use, a test by a ground wire, showed the presence of some other ground connection; and, as a natural consequence, those in charge of the lights were disposed to doubt the adequacy of the magnets used to test the insulation of the system.

SPARKS.

—— THE PARC MONTCEAU, placed in one of the most fashionable parts of Paris, is now lighted by Jablochkoff candles with success.

—— THE PRINCIPAL STREETS OF GRAND RAPIDS, MICH., and a large number of stores, hotels and business houses in that city, are beautifully illuminated by 170 of the standard lights of The Fuller Electrical Company.

—— A STRONG BREATH.—On a clear, frosty evening, some young men were chatting in Madison Square, when one noticed that the electric light showed the shadow of the vapor in the breath, very clearly upon the pavement, and called those present to witness, that his companion's breath was strong enough to cast a shadow.

—— THE WHEELING ELECTRICAL COMPANY, organized some months ago, has recently placed itself in position for continuing the operation of The Fuller Electrical Company's system, which it has had in use for six or eight months past, and for materially extending the same in the city of Wheeling and its vicinity.

—— ON A COAL WHARF, in Lynn, a St. Bernard dog, in the office, barks when the telephone call rings, if no one is in the office, but when any one is present, he does not appear to notice it. So, when the main office, in the business quarter of the city, wish to communicate with the wharf, if they hear a good natured bark, it is known that no one is in the office on the wharf.

—— MR. GEO. F. MILLIKEN, for many years manager of the Western Union Tel. Co. at Boston, Mass., has lately established an agency for the sale and installation of the apparatus of The Fuller Electrical Company, having his headquarters at 37 Pearl Street, Boston.

—— IN EXPLANATION of the statements made upon the increased economy of steam navigation, in the editorial of our February issue (page 42), we would state that the Persia (1856) consumed 14,500 pounds of coal, during the passage across the Atlantic, for every ton of cargo. The Arizona (1882) has made the passage with a consumption of 450 pounds of coal to the ton of cargo.

—— MESSRS. MAWSON AND SWAN, of London, have introduced a small accumulator, which is said to be capable of supplying one lamp continuously for two hours. The power of the lamp is not mentioned, but it has been used for taking photographs. The accumulator weighs five pounds. The modified Planté secondary batteries, used at the Savoy Theatre, weigh less than four pounds,

—— ELECTRICITY FURNISHES a new way of obtaining money at fairs. Place a coin in a basin of water, connected to one wire of a coil, and for a dime or so, allow persons to try and pick out the coin, on condition that they hold the other electrode. It is advisable that the resistance of the water be decreased by dissolving salt in it. If the battery and coil are properly arranged, no mortal can grasp a coin under four inches of water.

—— A GENTLEMAN, when in an office at the corner of Oliver and High Streets, Boston, was much startled because a thread of fire reached from his ear to a gas fixture. He had previously been in a manufactory, and wearing rubber overshoes, became charged with electricity from belts, and his gloves prevented a discharge when touching doors, etc., until the aforesaid ear came in proximity to the gas fixture. Several persons witnessed this phenomenon.

—— THE LONDON *Times*, says: In following the development of electric engineering, all the world is learning new terms and new language. Words which three years ago either did not exist or were understood only by men of science, are to-day in the common language of engineers and their workmen—to-morrow will be used by the general public. "Electromotive force" and "current," "volts" and ampères," are becoming terms as well known, as "pressure of water" or "cubic feet of gas," and it is necessary that this should be so, as the time is fast approaching when the public will find their quarterly bills for the supply of electricity made out in "volts" and "ampères," and will have a right to sue their local electric company if their daily supply of "current" is insufficient, or is given at a wrong "electro-motive force."

—— *Nature* says, a new electrical paper, *Electricity*, has issued its first number at Buda-Pesth. It is written in the Magyar language. The first paper of this description ever published was called *Les Archives de l' Electricité*, and was published by M. de la Rive, at Geneva, in 1840; and the first issued in England was edited by the late Mr. Walker, in 1843, under the title, *Electrical Magazine*. None of these papers lasted for more than three or four years.

—— THE ADVANTAGE OF lighting vessels by electricity was clearly demonstrated recently. The steamer Carolina, of the old Bay Line, between Baltimore and Norfolk, ran into the British steamship Riverdale, in a dense fog off Cedar Point, on Chesapeake Bay. The electric lights of the Carolina were extinguished only in the damaged part of the boat, and her officers think that if she had been lighted in any other way, a conflagration would have followed the collision.

—— A YOUNG MOTHER, hearing her infant cough, in the night, summoned the family physician by telephone. The doctor did not wish to come out in the storm, unless it was absolutely essential, so he asked many questions, relative to the character of the difficulty, but the answers were unsatisfactory, until the infant was held before the transmitter, and, by its cough, satisfied the physician that it was merely a cold, and not the dreaded croup, and therefore advised them what course to take.

—— A CONDUCTING WIRE of a Brush day circuit, was cut by the employee of a rival company in Boston, the other day, and his unappreciative employers informed him that they carried on a competition on a different basis, and gave him permission to find employment with some other company. Nevertheless, the man will never do so again. The blinding flash of an arc, about two feet in length, scared him and made the nippers blue; and, although standing on a floor, he received a severe shock, probably from the pulsations of the current.

—-THE NEW CAPITOL COMMISSIONERS, in their annual report to the Legislature, state that the results of the Maxim and Weston installation at the Capitol has been most satisfactory. That the advantages derived from the use of the electric light, are not only in the fact that the light is steadier, clearer, more healthful, and in every way more desirable than gas, but it is more economical. The commissioners recommend, in view of the economy in cost, and the healthful and perfect character of the light, that it be introduced into the legislative departments and suites of rooms.

—— THE VENTILATION of the State House, in Boston, has been poor, and the difficulties in the way have not been fully mastered, by the expensive and thorough changes, made at various times. With the increase of business, in this building, the matter of ventilation has been a serious question, A partial solution is to be attempted, by preserving some of the air from vitiation, by substituting electric lights for gas. Speaker Marden has appeared before the Committee on Public Health, relative to the matter, and it is said that the legislation necessary to make the change in light, will be carried into effect.

—— AT THE ANNUAL FAIR of a Grand Army Post, a very neat electrical railway, made by a youth of eighteen years, attracted much attention. The railway was five inch gauge, and ran around the hall, about ten feet above the floor. The two rails formed the conductors of a bi-chromate battery of four cells, while a small motor was contained in the locomotive. This apparatus did good service in advancing the objects of the fair, by giving patrons an opportunity to place a dime in any compartment of the four cars, forming the train, when the train would speed to the other terminus, and each ten cents replaced with a sealed package, on the "grab box" principle. The current was reversed in the rails, and the train returned. The train was stopped in a very ingenious manner, by leaving an opening in the rails, about ten feet from the terminus, where it also met with an up grade. The withdrawal of the motive power, and the slight ascent, were enough to bring the train to an easy stop, when it was caught by a latch; when the latch was opened, the train would move along the incline, by virtue of its own weight, to the place where it would reach the portion of the railway which formed the conductors.

—— THE PRINCIPLE of the well-known apparatus, using the bending of a compound bar of iron and brass, to close a circuit and sound an alarm, when the temperature of a room exceeds a fixed limit, has been put to a novel use, as an alarm for hot journals, in a large shop in Hartford, Conn. In the journals of all the shafting, except the countershafts, are small bars, made by soldering a brass wire against a thin strip of steel. When any bearing becomes warm, the bar bends, as the brass wire expands in the proportion of five parts, to every three parts that the steel expands. The bar is secured at one end, and, when bending, opens a circuit, and gives an alarm in the engine room. There are several circuits, so that the vicinity of the difficulty is known at once. The bars are so regulated, that an alarm is given long before a journal becomes seriously warm; and since its use there has been no difficulty, caused by hot bearings.

AT A RECENT ADDRESS after the dinner given to General Sherman on his sixty-third birthday, he eloquently said: When we who are seated at this table to-night, look back over the past half century and compare it with any other equal period of which history treats, we must confess that our lot has been a happy one. Steam and electricity have brought all parts of the human family into closer and more friendly relations, and give just reason for hope, that before another century passes, Burns' prophecy will be fulfilled—

"When man to man the world o'er
Shall brothers be for a' that."

The photograph, the telephone, the McCormick reaper and hundreds of labor saving machines have, in our day, vastly added to the world's wealth, and the ability of every man to enjoy his fair share of the fruits of the earth, and the embellishments of life.

—— THE *Lowell Daily Courier* says: The circuits of the Electric Light Company (Arnoux and Hochhausen), at Lawrence, Mass., are arranged with much judgment. Starting from the lighting station on the south side of the Merrimac River they cross over to the city, and are placed on poles along an alleyway between the two parallel business streets. As the wires enter at the rear, the facades of the buildings are not defaced by wires reaching from every direction in space. The wires are of like polarity as they reach the station, and as one and the other alternately loop to customers, there is rarely a difference of potential between the two circuits, where they approach each other, of more than that due to four lamps; and the difference is never enough to cause any of those deplorable accidents which sometime happen to careless workmen. After extending through the business portion of the city, the wires cross on another bridge and return to the lighting station.

—— THE TELEGRAPHIC AND TELEPHONIC PROTECTOR COMPANY, of Philadelphia, is a corporation recently organized, with a capital of $1,000,000, for the purpose of introducing the new scientific apparatus, from which it takes its name. The *Scientific Times and Mercantile Register*, says: that the "protector" was invented by Mr. M. D. Conolly, of this city, and is not only the best device for the purpose yet brought out, but the only completely automatic protector now known. Externally, with its two magnets and its knobs, it looks to the eye of the uninitiated, very much like a small telegraph instrument; but it is really, as its name implies, an automatic protector, intended to divert or neutralize any sudden overplus of current; and, according to the testimony of electricians, guaranteeing entire immunity from the many accidents caused by a sudden excess of electricity where it is not wanted. From experiments made, it appears that the new invention, as long as the currents are normal, remains in quiet expectancy and vigilance, abstaining from all interference with the working of the instrument, telegraphic or telephonic, as the case may be; but the moment its magnets become, so to speak, conscious that the passing current is abnormal, its wire instantly connects itself with the instrument, assumes the responsibility for the excess, and by the action and reaction of its magnets, neutralizes the same before it can do any damage. The numerous accidents that have already occurred in consequence of an excess in the electric current, render this little attachment a most timely and useful invention. Thorough tests have been made, both in New York and Philadelphia, and from all it has come out triumphant. At the Western Union offices in New York, thirty-two tests were made before the celebrated French electrician, M. De Imfreville, and Mr. G. C. Hamilton, another distinguished expert; all resulting most satisfactorily.

—— **We hear more** of the effects of the electric storm; and in addition to the phenomena already mentioned in previous issues, we have learned of so many instances of its effects upon electric light systems, that it is probable that there was not a public lighting circuit in New England, where it was not found necessary to reduce the number of dynamo machines upon circuits driven in series, or to diminish the speed of the armatures, in order to keep the lights in satisfactory condition. In Springfield, Mass., out of twenty-four wires in one telegraph office, it was rarely that over two could be used at any time In the central office of the Haverhill Telephone Co., the terrestial electricity kept the armature of the call to the magnet, so that no signals could be transmitted, because the alarm could not be used to notify persons. The terrestial current was not constant, and efforts which were made elsewhere, to neutralize it by a counter-current from batteries, were unsuccessful. It is, indeed, fortunate that no destructive fires were due to any effects upon the electric fire alarm systems, so that an alarm of fire was not signaled to the department. Yet, such results would have ensued, if fire alarms had been struck at certain times and places.

—— **On Friday evening**, February 16, about 300 gentlemen assembed at Hotel Vendome, Boston, by invitation of Spencer Borden, the Manager of the Edison Electric Company for the New England States, to listen to an explanation of the system, in reference to the formation of a company for lighting a district in Boston from a central station, similar to the one in New York. Major S. B. Eaton presented a clear and concise statement of the salient points in the Edison system of electric lighting. Without digressing into any comparisons with other methods of electric illumination, he gave some interesting facts relative to the Edison electric lighting station in New York. Since opening the station on the 4th of last September, the electricity has been continuously furnished, day and night. There were serious defects in the engines, which gave trouble at first, but they were not of an electrical nature, except so far as irregular speed of engines interfered with the uniformity of the current produced by the dynamos. Now, that new steam engines have been introduced, everything is satisfactory. The statement was made that the company had invested $1,750,000, and from a beginning of 85 customers, had reached 319 houses, which require 6,500 lamps, and the number is being increased daily, as fast as the wires can be installed by their men. Of the 40,000 gas burners in this district, 25,000 were used between 5 and 6 P. M. Mr. Spencer Borden exhibited maps of a portion of Boston, which it was proposed to light by Edison lights. In the district bounded by Bromfield, Tremont, Boylston, Kneeland, Kingston, and Franklin Streets, which is about 2,000 feet long, and 1,000 feet wide, are 34,000 gas jets, of which 24,489 are burned between 5 and 6 P. M. Less than 20,000 Edison lights would be the equivalent of these gas lights. This district contains one gas jet to every 90 square feet area, and is, therefore, expected to be a much richer district in probable returns than the New York district, where there is one light to 208 square feet, or about 43 per cent. as much light used over a given area. Short remarks were made by Mr. Thomas A. Edison, Mr. Henry Villard, and others. Statements of the finances of the central lighting station in New York, which were of a most satisfactory nature, were shown, but not for publication. It was announced that the policy of the Edison Company would be to begin the formation of lighting companies in the leading cities.

ILLUMINATION OF INTERNAL CAVITIES BY MEANS OF THE ELECTRIC LIGHT.

At the last meeting of the Northumberland and Durham Medical Society, I exhibited Mr. Payne's improved electric light appliances, and showed how some of them might be employed for microscopical and clinical purposes. For the past few months I have been engaged with Mr. Payne in suggesting adaptations of these instruments to the purposes just alluded to. Remembering that Sir Henry Thompson, more than a year ago, explored the bladder by means of the electric light, and that Leitz, of Vienna, is devising instruments for illuminating the throat, posterior nares, bladder, uterus, &c., Mr. Payne made an instrument by means of which the throat could be examined. Having at the present time a patient in the infirmary who is suffering from hydatid disease of the liver, and on whom the operation of abdominal section with incision of the liver had been performed, took advantage of the opportunity and succeeded in lighting up the interior of the cyst by means of the electric light. For this purpose Mr. Payne devised and constructed a brass tube, electro-plated, nine and a half inches in length, and eleven-sixteenths of an inch in diameter externally. One end of this tube was funnel shaped, and the other was closed by a piece of glass; down this tube was inserted a narrow cylinder, which carried a Swan's lamp and the electric wires. This tube, with its glazed extremity, was smeared with carbolized oil (although in future I shall use carbolized glycerine for the window of the tube), and with gentle pressure I succeeded in passing it through the abdominal incision into the interior of the liver. The lamp was at once lit, and I had the pleasure of observing a grayish red condition of the wall of the cyst, studded across which, were numerous yellow-white spots, evidently pus; a slight oozing, or sweating, was also noticed on the wall of the cavity. The illumination of the interior of the liver by means of the electric light was in every way satisfactory and successful, and although it is of little aid in the treatment of the case in question, it has shown us that the lighting up of the internal cavities is not only a possibility, but a matter of comparative ease. With the extremely small size of the Swan's lamp required (it is not much larger than an ordinary bean), and which gives a light equivalent to that from three candles, and with the improved instruments which Mr. Payne is devising, I see how the electric light might become useful in operations for vesico-vaginal, or recto-vaginal, fistula, and in certain diseases of the bladder. Before making use of this illuminating endoscope on the human subject, I tried its effects in a dark chamber; I read with ease a piece of print placed therein.

MR. PAYNE'S REPORT.

Leiber's arrangement contains an electric lamp in which platinum wire is heated by means of battery power and rendered incandescent. The arrangement I made is of much simpler construction, gives a perfectly pure light, and develops less heat. It consists of an electro-plated outer tube, nine inches and a half long by eleven-sixteenths of an inch external diameter, glazed at one end with a stout piece of plate glass made perfectly secure and tight.

A Swan's electric lamp is used, the filament of which is carbon and rendered incandescent by means of battery power. It is hermetically sealed in a glass shade; and water, conveyed to and fro through very small brass tubes, is made to circulate round the lamp. The light from this lamp is perfectly pure, and exhibits the conditions of things in their true and natural color. For prolonged observation, I should prefer to use either a Grove's or Bunsen's battery, but in the demonstration just referred to, four cells of a modified Leclanché battery were employed, and answered admirably. It is advisable to have as great a pressure as possible for the water supply, so as to insure perfect circulation, and for this I suspended from a hook, fixed near the ceiling of the room, a tin can containing water, connecting it with the brass tube by means of lengths of india-rubber tubing.—Thomas Oliver, M.D., M.R.C.P., Physician to the Infirmary, Newcastle-upon-Tyne, and J. B. Payne, F.R.M.S., Newcastle-upon-Tyne.—(*From the British Medical Journal.*)

BOOK NOTICES.

Allison's Webster's Counting House Dictionary and Dictionary of Electricity. W. L. Allison, New York. Eighth edition. $3.00, post-paid.

The first mentioned work contains 384 pages, and is based on Webster's dictionary, of the same title. The extensive sale of this book, has made it so generally known, that we may omit particular reference to its worth. The Dictionary of Electricity, that is bound with it, would deserve especial attention from us, had it been compiled with the ability and fulness which the subject requires. The plan is undoubtedly good, and in the absence of any similar work, it may be of some use. Electricity is a young giant, as it were, that is still in his swaddling clothes. Its growth has been rapid, and any treatises on the subject will have to be revised at frequent intervals. To properly present the advancement and present state of the science, would require much labor, care, and the collaboration of eminent specialists. Frequent reference is made, in the present work, to prominent publications, and thus the searcher after information is at least given further directions. The volume is tolerably well printed, and is strongly and tastefully bound.

BUSINESS NOTICES.

A MECHANICAL ENGINEER, of twenty years' experience in the manufacture, construction and management of Maxim, stationary and mining machinery, wishes to connect himself with the Electric Lighting business, either in the manufacture or construction departments. References of the highest character given as to integrity, capacity, and ability.

Address **Mechanic**, care of ***Electrician.***

CAUTION.

Certain statements having been circulated in reference to the Dynamo-Electric machine, made by us, which we call the **ARAGO RADIAL DISC DYNAMO,** and claims set up to the right to manufacture the same, independent of our control, we hereby inform all makers, purchasers, and users of the above type of Dynamo machines, that we hold certain underlying Patents on the same, and that no person or persons but ourselves have the power to grant licenses or rights to manufacture these Dynamo machines, and all parties are hereby cautioned against infringement of our Patents, by the manufacture or sale of the same.

The sale and use of these machines in the New England States, is in the hands of the Economic Electric Co., Boston, Mass.

For all other rights, address,

THE WHITE HOUSE MILLS,
HOOSAC, N. Y. ROBB MACKIE, Sec'y.

NOTICE.

AT a special meeting of the stockholders of the ELGIN TUBULAR IRON TOWER CO., of Elgin, Ill., held at their office, in the City of Elgin, pursuant to notice, on January 18th, 1883, at 10 o'clock a. m., the following resolutions were adopted:

Resolved: That the name of the ELGIN TUBULAR IRON TOWER COMPANY, of Elgin, Kane County, Ill., be, and the same hereby is, changed to that of the DETROIT TOWER COMPANY, of Detroit, Wayne County, Mich.

Resolved: That the general offices of the DETROIT TOWER COMPANY, as well as the business of the Company, shall be removed from Elgin, Kane County, Ill., to Detroit, Wayne County, Mich., an office being retained in Chicago.

Elgin, Ill., January 19th, 1883.

(Signed), GEORGE E. BOWEN, Secretary.

In pursuance of the above notice, we beg to announce that under the name and style of the DETROIT TOWER COMPANY, of Detroit, Mich., we shall continue the manufacture of

ELECTRIC LIGHT TOWERS,

(Under the Adams Patents),

and with our newly added facilities, are prepared to furnish Towers for lighting cities, villages, parks, railroad yards, docks, &c., &c, with the Electric Light, promptly and to the satisfaction of purchasers. The Electric Light has demonstrated the great economy in its use over any other light—and the Tower system to be the true way for its distribution, as the elevation of the light greatly increases its radial capacity. It is safe to say that a Tower 150 to 175 feet high, with six 2,000 C. P. Brush lamps, will light a radius of 2,000 feet. Cities that have introduced these Towers and the Electric Light are respectfully referred to as enthusiastic advocates of the Tower system, and its wonderfully pleasing results. They one and all testify to the utility, economy, beauty and strength of the Towers.

In the city of Denver, the Towers having withstood two fearful storms, Mr. W. B. Rundle, Manager of the Colorado Electric Company, in ordering two 150 feet Towers, to replace wooden ones blown down, says: "this will show you that the Tower system is not a failure in Denver." The cities that are now using our Towers, are Aurora, Ill., Topeka, Kan.; Fond du Lac, Wis.; Bay City, Mich.; Savannah, Ga.; Fargo, Dakota; Fairfield, Iowa; LaCrosse, Wis.; City of Mexico, Mexico; Denver, Col.; Tipton, Iowa: Rock Island, Ill.; and many other cities are considering the introduction of the light by means of the Tower system. Railroad managers are specially requested to examine this system for lighting their yards and depot grounds. The people say: "Let there be light!"

PRICE LIST OF TOWERS FOR ELECTRIC LIGHTING.

Height in Feet to Lamps.	*Towers, Plain, with Fixed Lamps.*	*Towers with Elevators.*
54	$300	
70	350	
86	425	
102	500	$650
134	850	1,000
150	1,050	1,200
183	1,500	1,650
200	1,800	2,000
250	2,650	3,000

Prices are given for the Towers delivered on board the cars in Detroit—freight to point of Destination added. The ordinary cost of erection is included in Price List. Foundations extra.

Estimates given for Towers of any height, and any information very cheerfully furnished on application. Correspondence is solicited.

DETROIT TOWER COMPANY,
88 Griswold Street,
DETROIT, MICH.
GEORGE S. BOWEN, Manager.

Chicago Office, No. 5 Ogden Building.

PATENTS FOR JANUARY AND FEBRUARY, 1883.

JANUARY 23d.

270,884 Electric Battery, Fluid. E. Berliner, Boston, Mass.
271,169 Electric Induction Machine. A. G. Waterhouse, New York, N. Y.
271,172 Electric Light. E. Weston, Newark, N. J.
271,140 Electric Light and Gas Burner Combined. W. A. Shaw, Brooklyn, N. Y.
271,175 Electric Motor. S. S. Wheeler, C. G. Curtis, and F. B. Crocker, New York, N. Y.
270,954 Lamp, Electric-arc. C. P. Jürgensen, Copenhagen, Denmark.
271,173 Lamp, Electric-arc. E. Weston, Newark, N. J.
271,171 Lamp, Incandescent, Electric. E. Weston, Newark, N. J.
271,059 Lamp, Magazine Electric. A. T. Gifford, Providence, R. I.
270,907 Telegraphs, Optical Attachment for Printing. W. J. McCausland, Philadelphia, Pa.
270,990 Telegraphy, Multiplex. C. Selden, Toledo, Ohio.
271,188 Telephone Receiver. S. H. Bartlett, and H. E. Waite, New York, N. Y.

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271,299 Galvanic Battery. J. A. Barrett, Chicago, Ill.
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271,576 Lamp, Electric-arc. J. R. Finney, Pittsburg, Pa.
271,456 Lamp, Electric-arc. W. Hochhausen, New York, N. Y.
271,458 Lamp, Electric-arc. W. Hochhausen, New York, N. Y.
271,302 Lamp, Incandescent Electric. A. Bernstein, Boston, Mass.
271,457 Lamps, Automatic Cut-out for Electric. W. Hochhausen, New York, N. Y.
271,548 Telegraph Cable, Submarine. S. Trott and F. A. Hamilton, Halifax Nova Scotia, Canada.
271,262 Telegraph Cable Pipe. W. R. Patterson, Chicago, Ill.
271,279 Telephone Exchanges, Circuit for Multiple Switch Boards for. C. E. Scribner, Chicago, Ill.
271,324 Telephone, Mechanical. G. K. and H. C. Farrington, Kirksville, Mo.
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271,707 Annunciator and Fire Alarm, Electric Hotel. A. T. Hess, Des Moines, Iowa.
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271,882 Car Signal, Electro-magnetic. J. W. Marley, Chicago, Ill.
271,825 Electric Circuit Wires, Fastening for. H. G. Fiske, Springfield, Mass.
271,948 Electric Current Regulator. E. Thomson, New Britain, Conn.
271,972 Electric Machine, Dynamo. W. Baxter, Jr., Jersey City, N. J.
271,979 Electric Machine, Dynamo and Magneto. E. Gordon, New York, N. Y.
271,928 Electric Machine, Dynamo and Magneto. C. A. Seeley, New York, N. Y.
271,615 Electric Machine Governor, Dynamo. T. A. Edison, Menlo Park, N. J.
271,616 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
271,654 Electric Machine Regulator, Dynamo. J. F. Ott, Newark, N. J.
271,947 Electric Machines, Commutator for Dynamo. E. Thomson, New Britain, Conn.
271,913 Electric Switch Board. T. J. Perrin, Brooklyn, N. Y.
271,832 Electrical Conductor. P. G. Gardner, Jr., J. W. Le Roy, and G. K. Tinker, North Adams, Mass.
271,914 Electrical Switch Board. T. J. Perrin, Brooklyn, N. Y.
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272,001 Gas Lighting Burner, Electric. H. J. Warren, West Bridgewater, Mass
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271,994 Insulator, Electrical. D. M. Steward, Cincinnati, Ohio.
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271,903 Telephone Transmitters, Mouthpiece for. A. S. Nichols, New Haven, Conn.
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272,366 Electric Machine, Dynamo. E. Weston, Newark, N. J.
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272,221 Electric Wires, Underground Conduit for. J. S. Du Bois, Camden, N. J.
272,362 Electrical Transmission of Power, Device for Regulating the. E. Weston, Newark, N. J.
272,363 Electrical Transmission of Power, Device for Regulating the. E. Weston, Newark, N. J.
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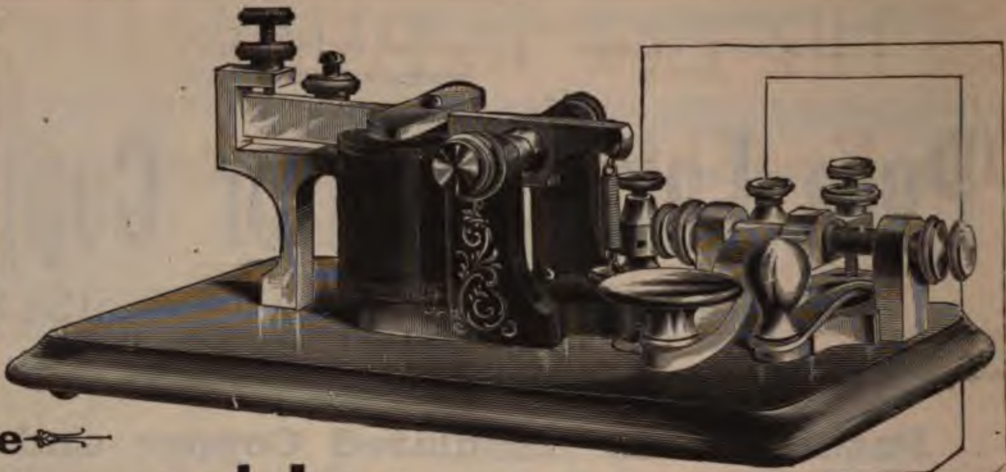

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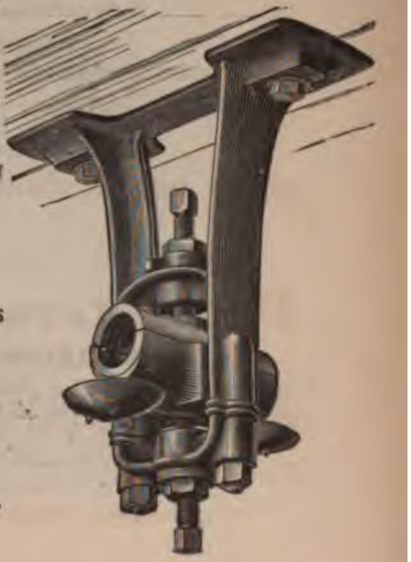

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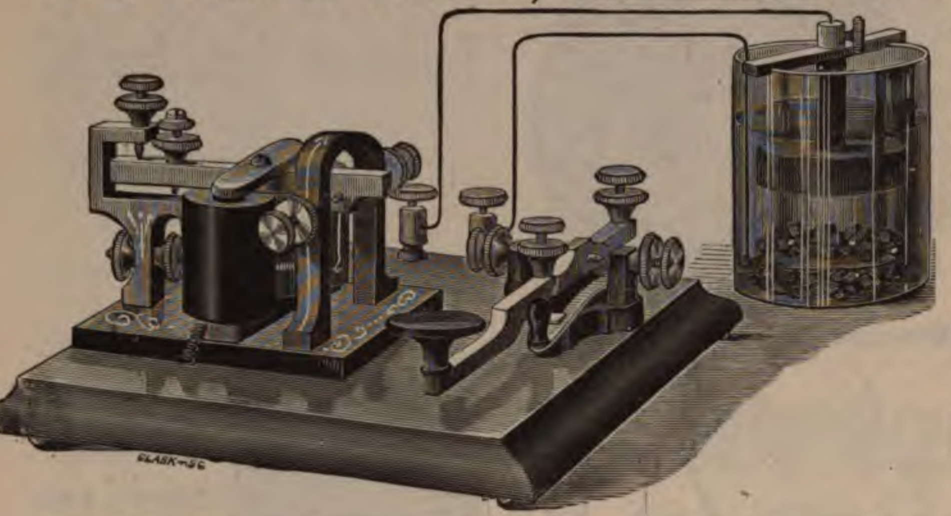

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THE ELECTRICIAN.

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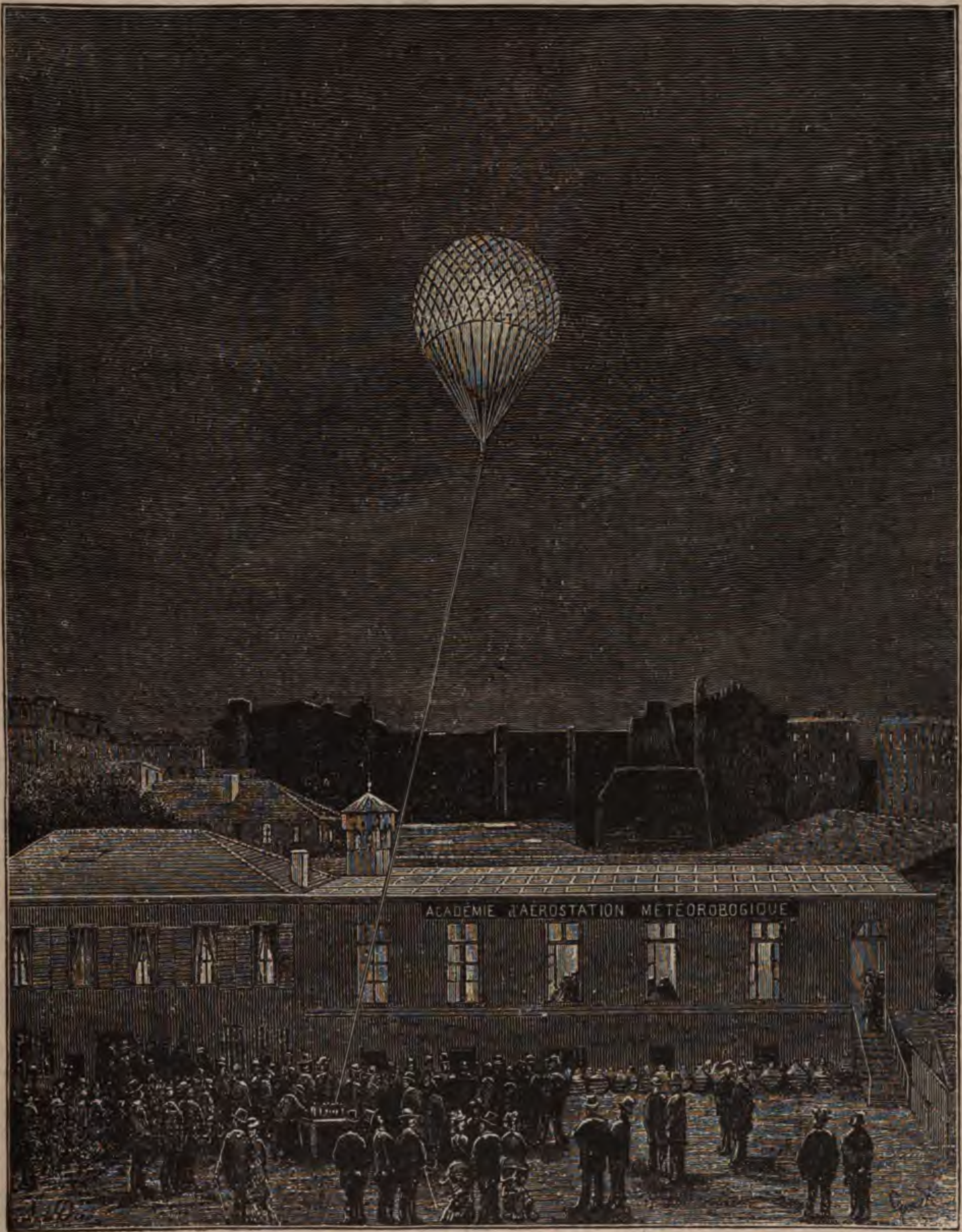


SIGNALING BY ELECTRIC LIGHT.—See page 94.

ELECTRICITY APPLIED TO BALLOONS.

THAT a great many important objects may be obtained by the combined use of electricity and balloons, can no longer be doubted. In the first place, a balloon can ascend to any desirable height, and thus the electrical focus can attain a far higher elevation than even the tall pole of Union Square. That measures could be adopted to anchor the balloon even on the most stormy night can neither be gainsaid. The striking illustration on our front page, from *La Lumière Électrique*, represents an experiment in the above direction, made lately at La Chapelle, France.

The balloon was made luminous by an incandescent Swan lamp,—the experiment being under the direction of an aeronaut, M. Mangin. The balloon was made of waterproof paper; its diameter measured about eight feet. It was filled with pure hydrogen gas, while a Swan lamp was hung in the centre, with wires connecting it with a pile of twenty-four elements, and placed on a table, as shown in illustration.

When the inflation was judged to be sufficient, the lower opening was closed, and as the current traversed the conducting wires, the electric focus became incandescent, and the balloon was transformed into a vast luminous globe, which illuminated the surrounding buildings in the most magnificent manner.

It was at once perceived, that this new kind of aerial illumination possessed great advantages for signaling, as the current can be intercepted or restored instantaneously. The illuminated mass can be seen at a great distance, and it can be made serviceable both to forces on land and sea. An enemy's fort or camp can be investigated, while the rapid interception of current and extinction of light would prevent any locating of the balloon itself.

M. Mangin has even declared his intention to do away with the connecting wires; he would simply have an electro-magnetic machine in the balloon, which could be worked by hand. The presence of the inflating gas constitutes a great danger, however, for any mishap to the conducting wires would lead to a catastrophe.

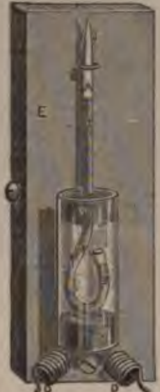
Messrs. Tissandier, who have also given great attention to aerial navigation, have constructed light piles with bi-chromate of potash, composed of twenty-four elements united in tension, for working an electro-magnetic motor which will in turn work the aerial screw of an elongated balloon. Experiments with Siemens Brothers' motor were made in January, and proved that a velocity of from four to five yards per second could be imparted to the aerial ship.

—— THE *London Times* says: The electric light has been applied of late in various cases, where the effect has been singularly picturesque. Thus, during a congress of Greek medical men at Athens last year, several electric lamps were placed at elevated points about the Acropolis, and the aspect of the ruins so lit up is said to have been very striking. The Company of Steam Navigation on the Rhine and the Lake of Constance started last year a night service of steamers supplied with Bürgin electric lamps, to illuminate the beautiful banks of the river. The steamer left Schaffhausen at fall of night, and sailed to Biesingen, and passengers were enabled to enjoy the scenery in those novel circumstances. Further, the falls of the Rhine have been illuminated at night, by a powerful electric light placed on the right bank. To appreciate fully the remarkable appearance of the foaming torrent so lit up, it is necessary to reach the principal rock, on which is a small pavilion, and where the stream divides into two large parts. Again, there is a regular night service instituted between Cannes and the Lerin Islands, the vessel being the steam yacht "Cannois," which has a powerful Mangin lamp, also thirty-four Swan lamps, arranged between the masts and elsewhere. The electric light guides the course in the difficult navigation which often occurs in these trips, and furnishes many lovely views of scenery.

A NEW THERMOSTAT.

AT a meeting of the Society of Arts, held at the Institute of Technology, Boston, Mr. F. C. Childs described the new thermostat of the Automatic Fire Alarm Association of that city.

The object of the device is to close an electric circuit by means of a slight increase of heat, and its present application is to give an alarm of fire by ringing an annunciator which indicates in what room the danger exists.



A. Hydro-carbon.
B. Mercury.
C. Insulator.
D. Conducting Wires.
E. Base-board.

It differs from the well-known devices—containing a compound bar of steel and brass, which deflects with change of temperature—and closes a circuit by using the vaporization of a hydro-carbon to serve this purpose.

Referring to the illustration, it will be seen that this instrument consists of a glass U-tube, with arms of unequal lengths (the longer arm being closed), and projects from a cup which contains the tube.

The upper arm of the U-tube contains a small amount of hydro-carbon liquid, and the remainder is filled with mercury.

The lower part of this cup is made of hard rubber or some other insulating material, and holds the two poles of the circuit, one of which enters the cup through a hard rubber screw, and the other is connected to the base of the cup.

When the temperature exceeds any fixed limit, a small amount of the hydro-carbon is vaporized, and its expansion forces out some of the mercury which collects at the bottom of the cup, and forms an electrical connection between the two poles and completes the circuit.

The thermostat is five and a half inches high, and one and a half wide; and when placed in position, an ornamental metal covering renders it sightly and protects it from injury.

If it should be tampered with, or broken, the accident would spill enough mercury into the cup to sound an alarm.

This instrument does not require any mechanical nicety of adjustment, as the temperature at which the alarm will sound depends wholly upon the boiling point of the hydro-carbon used.

As there are a regular series of liquid products of petroleum which vaporize at points from the lowest artificial cold to 600 degrees Fahrenheit, there are no obstacles from that source. For most places a liquid which vaporizes at 118 degrees is used.

This thermostat is more sensitive than is possible in any apparatus operating by the expansion of metals, because the quantity of heat necessary to raise a certain volume of a hydro-carbon a certain number of degrees, is less than the quantity of heat required to elevate the temperature of an equal volume of metal to a corresponding increase in temperature.

The operation of this thermostat depends upon the vaporization of an almost infinitesimally small quantity of the liquid; not more than .000002 of a cubic inch. The heat absorbed in raising the temperature and converting into vapor this small amount being about .00001 of a thermal unit.

To raise the temperature of the mercury in an ordinary thermometer, the range which would be required for the operation of the thermostat, say from 60 to 120 degrees Fahrenheit, would require a much greater quantity of heat. If the mercury in the bulb weighed one-tenth of an ounce, or .00625 of a pound, the increase of temperature being 60 degrees and the specific heat of mercury being .0333, then the quantity of heat necessary to raise the mercury in the thermometer 60 degrees, would be

.00625 x 60 x .0333=.01249 of a thermal unit, being 1,249 times the quantity of heat required for the thermostat.

As a matter of fact, with experiments made by exposing these instruments to quick fires, their operation was so rapid that the thermometers gave no indication of the exact temperature at which the thermostat closed the circuit.

The speaker gave detailed accounts of tests of this apparatus in places where it was in use; and in the presence of the audience ignited a piece of newspaper, and the thermostat caused an alarm to be rung in thirteen seconds.

The Parker House, in Boston, is provided with 300 of these thermostats and they are to be placed in other hotels, and also in a number of manufacturing establishments.

NEW GALVANO-CAUTERIZING BATTERY.

GALVANO-CAUTERIZING operations are becoming more and more frequent, and we believe not without reason, for in many respects the method presents incontestable advantages, which, however, it is not our purpose to discuss at present, but its direct dependence upon the manner of generating the electric current is a matter not unsuited to our present attention.

The inconveniencies of this method are all exterior and material; they include the transportation and manipulation of the battery, both of which frequently cause the spilling of its corrosive liquid contents, which damage whatever they may fall upon.

Mr. Chardin, an ingenious constructor of electrical apparatus, especially as applied to medical and surgical operations, some time ago devised a battery expressly intended to operate the instruments in galvano-cautery, which, it seems to us, is likely to be a valuable auxiliary.

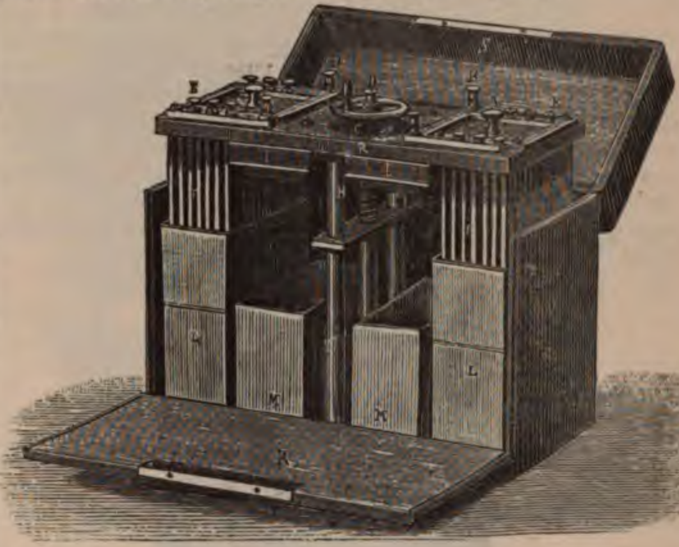
This battery is so constructed that an easily portable box contains all its parts, ready to act without fear of the liquid being spilled. In a few moments the whole apparatus is ready for use, in even less time it may be re-packed in readiness for removal.

It consists of a box, the cover of which S, and one side R, open upon hinges. Across the middle of the box three hollow columns, united at their upper ends by a horizontal bar, are fixed vertically in a line. The two outside columns are highly polished inside, to admit movable cylinders HH, fixed at the top to a metallic cross-piece, which is supported at any height by a screw tapped into the middle column. Upon the metallic cross-piece, thus supported by the screw and guided by the cylinders HH, a wooden table, as large as the inside of the box, is fixed, from the under side, of which the plates of the battery depend in the usual manner. Through the centre of this table the shaft of the screw passes, and terminates in a wheel and handle C. By turning this wheel, the table may be raised or lowered at pleasure.

The plates of the battery consist of carbons and zincs, three zincs and four carbons being suspended from each side of the table. These occupy but about half the space upon each side. In the unoccupied spaces below the table are fixed two covers of india-rubber I, I. The apparatus is completed by four ebonite troughs of the same size in plan, and all placed in the box at the same time. But they are of different heights, two of them LL, which contain the exciting liquid (a mixture of bi-chromate of potash and sulphuric acid), being as high as the box, while the other pair MM, are only half as high.

When it is desired to set the battery in operation, the plates are raised by the screw, and the troughs LL, half full of the acid, are placed in the position shown, their exact situation being assured by placing the half troughs MM, in their places, as also shown in the Fig. Reversing the screw, lowers the zincs and carbons into the liquid with a motion so gentle that no splash can occur. The current is regulated by raising or lowering the plates in the acid.

The operation ended, the table with its plates is raised by the screw until the plates are clear of the troughs LL, which may then be removed, and the half troughs MM, slid sideways into their places. The troughs LL, are then put in the places occupied (in the Fig.) by the half troughs MM, and the table is then lowered by the screw. The rubber covers I, I, then fit upon and close the acid reservoirs, and, by the screw, may be so tightly pressed upon them as to close them hermetically, and the box may then be shut, and safely transported. No acid can spill from the hermetically sealed reservoirs, and the drip from the plates is caught in the half troughs under them, and thereby prevented from injuring the apparatus in any way.



Without wishing to advance this arrangement as an invention of the first order, it seems to us that it displays an ingenuity, and acquaintance with practical requirements, deserving of recognition. Although proposed but a short time ago, it has been adopted by the hospitals at Lyons, Montpelier and Brussels, and if we are not mistaken, it is also used in the Bichat Hospital, in Paris. It appears effectually to obviate the inconveniences which attend the employment of the batteries previously used.

The zincs and carbons are about 5½ inches square. The three zincs and four carbons on each side are combined for quantity, so as effectually to constitute two large single plates. Binding posts, conveniently situated, permit the use of one or the other set of plates at pleasure, or if it be desired, the two separate batteries may be connected in tension, by a wide metallic band. The carbons are platinized. At their upper part they are covered with a coating of electrolytically deposited copper, to which is soldered the metallic sheet, which unites the four carbons of each element into one single plate. This arrangement assures the continuity of the contacts, and thereby maintains constant the resistance of the battery.

It is apparent that this apparatus can give neither more nor less than any other bi-chromate of potash battery, but from the point of view of its intended use, it can serve a desirably long time. The raising and lowering of the plates may be easily and frequently performed during the continuance of the surgical operation, and thereby may be avoided, the polarization which so soon occurs, when the plates remain quietly in the liquid. In all other respects it corresponds to the batteries now in use. C. M. G. in *L'Electricien.*

DOMESTIC ELECTRICITY.

MAGNETIC telephones are specially adapted for small distances, and for places where telephonic conversation is not disturbed by outside noises. For workshops, &c., pile transmitters are far preferable on account of their greater power and distinctness. A few words on the pile transmitter and receiver will be in place before treating of the arrangement of the stations.

PILES.

We give the preference, in all cases, to the Leclanché pile for telephonic purposes. The new elements, with agglomerated plates, are much superior to the old elements with porous vase, which exercised an injurious influence by its greater interior resistance. It must not be forgotten, however, that the Leclanché elements are polarized when they are kept in closed circuit on the telephone for a certain time, and for this reason communication with the circuit should be cut off when the conversation is finished.

TRANSMITTER.

There is no end to the variety of telephonic transmitters, although when first invented they were divided into two classes only: Carbon transmitters and microphones. This, however, is altogether an artificial classification, for it is difficult, with all the various apparatuses at present in use, to make any such distinction. We will, therefore, use the general name of transmitter as applicable to any apparatus which is susceptible, under the influence of sound, of modifying its electric resistance in an undulatory and concordant manner with the vibrations of the said sound.

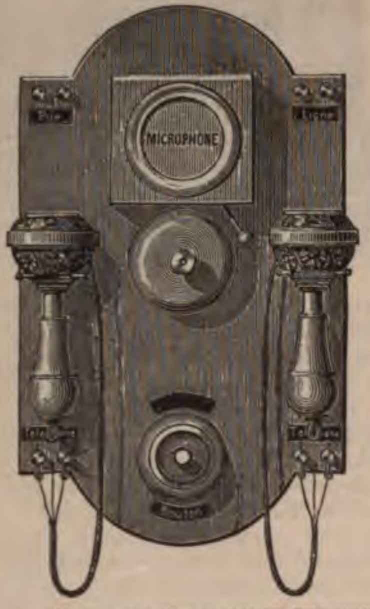


FIG. 1.—DUNAND'S TELEPHONIC STATION.

The simplest telephones are the best, and above all, those that one makes oneself with a few carbon crayons. The simplest transmitter is the Hughes' microphone—it is even too sensitive, and the "sputterings" that follow loud sounds are owing to this delicacy, which has to be reduced. This can be done in various ways: By inclining the board supporting the carbon cubes until it is perfectly horizontal or slightly sloping, or by putting a small folded paper in V shape between the board and the carbon crayon. In the transmitter of Locht-Labye, to which the inventor has given the pretentious name of *pantelephone*, the variable resistance contact is made between a stationary piece of platina and a small carbon lozenge glued to a sheet of cork that is suspended by two springs. The sheet of cork having little inertia and a large surface, follows the voice very satisfactorily.

In the last *electrophone* of M. Maiche—at least in the last one which we have seen—the contact is made between a carbon lozenge, fixed on a vibrating plate, and a carbon ball, which is suspended from a vertical lever, and giving a certain pressure that can be regulated by a counterpoise.

A very simple transmitter is thus described by M. d' Argy: Take a small board of walnut, pine, ebonite, or a Japanese screen, and fix it upright in a socket by means of two corks. Fix two pieces of carbon in the middle of the board, and put a pinch of coke between them. The coke can be kept in position with a piece of india-rubber tube of a feeding bottle. The vibrations of the board react on the contact formed by the powdered coke. All these simple apparatuses are with single or double contact. A method which gives very good practical results is to *multiply* the contacts, and to group them, either *in tension*, as in the ball microphone of Boudet, of Paris, or *in quantity*, as in the transmitter of Bert and Arsonval.

In Ader's transmitter there are ten carbons, giving 20 contacts, 4 in tension and 5 in derivation; Crossley's transmitter contains 4 pencils, 8 contacts—4 in tension and 2 in quantity; the Gower-Bell has 6 pencils, 12 contacts—4 in tension, 3 in quantity, &c.

To obtain satisfactory working with all these systems, the number of elements must be in proportion to that of contacts and their arrangement. If the contacts are in tension the elements must be put in tension, and the same rule for quantity.

The rule is: To have the interior resistance of the pile as near as possible to the average resistance of the transmitter.

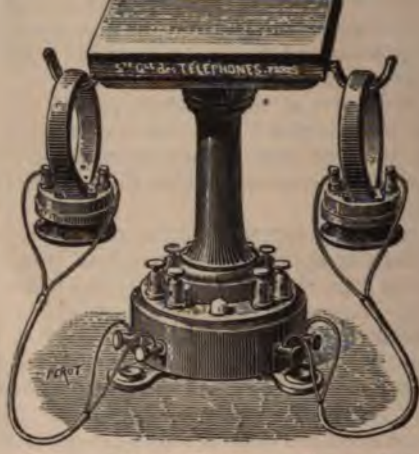

Sté Gle des TÉLÉPHONES, PARIS
PERAT

FIG. 2.—ADER'S PORTABLE TELEPHONE.

RECEIVERS.

These are all, more or less, on the original model of Bell's, and are based on the electro-magnetic actions, with the exception of the condensators which have not yet come into use. The systems generally used are those of Bell (ordinary and watch); the Trouvé, Maiche, Phelps, Ader, and that of Arsonval. The last three are doubled pole, like the magnetic telephones of Gower and Siemens. When the distances are not too great an ordinary bell will be found sufficient. The size of the wire round the coils depends on the distance and mode of working.

WORKING.

A transmitter can actuate a telephonic receiver in two ways: 1, Directly, without the intermediary of an inducting coil; 2, Indirectly by an inducting coil. The first method can only be used for very short distances—in a room for instance, and with a relatively large telephone. It can be easily understood that as the line increases, the total resistance of the circuit that is constituted by the pile, the transmitter, the receiver and the line is also increased, while the variations in resistance of the transmitter always maintain their absolute value.

The effect of these variations will be, therefore, so much less as the distance is greater; it soon becomes insufficient and then the sounds are no longer perceptible. This is not exactly the case with the induction coil system.

The transmitter works on a circuit of constant resistance which is constituted by its resistance proper, that of the pile, and of the primary circuit or coil inductor, while the receiver and the line are connected with the inducted circuit of the coil or secondary circuit. In these conditions the

THE INVENTOR OF THE TELEPHONE.

THE following letter, from Silvanus P. Thompson, on the invention of the telephone, appears in the London *Electrician* of March 10.

To the Editor of the Electrician.

SIR:—As your editorial note of p. 374 invites me to give the references that I have indicated in evidence of Reis's claim to be the inventor of the telephone, which he designed for the express object of transmitting human speech and other sounds of all kinds, I have much pleasure in giving you the very same references which I have myself obtained from the published writings of Graham Bell ("Researches in Telephony," *Journal of Society Telegraph Engineers*, 1877), and of Edison (see "Prescott's Speaking Telephone," p. 218).

1. "Telephonie," *Dingler's Polytechnisches Journal*, CLXVIII., p. 185, extracted from the *Jahresbericht des Physikalischen Vereins zu Frankfurt am Main*, 1860-'61, p. 57–64.

This is a scientific memoir by Philipp Reis, having for title "On Telephony by the Galvanic Current" On p. 58, he says his endeavor was to find an instrument which should reproduce the total action of all the organs set in action in human *speech* (menschlichen Spräche), and that he took the human ear as model, because the tympanum of the ear could respond to all sounds. After discussing the problem of representing the pressures of the air in sound waves by a "curve," he says, that if it is possible at any place to reproduce vibrations having a similar "curve," the very tones will be reproduced. He then says, that taking his stand on the principles laid down, he has succeeded in reproducing the tones of various instruments, and, to a certain degree, the human *voice* (die menschliche Stimme). After describing his instrument—the well-known combination of a tympanum, in imitation of that of the human ear, with an electric current regulator, consisting of an interrupting apparatus, which embodied the loose contact principle of the microphone, and which is, in many respects, exactly like the interrupter in the Blake transmitter—he says (p. 62):—"I give to my instrument the name 'Telephon.'" Later on he says that the reproduction of human speech, which he has attained, is not so clear as to satisfy everybody, and that, though the consonants are transmitted distinctly enough, the vowels are not equally so, and he proceeds to discuss why this is the case.

2. *Brix's Zeitschrift des deutsch-oesterreichischen Telegraphen Vereins*, 1862, Vol. IX., p. 125. This article is also reprinted in *Dingler's Polytechnisches Journal*, 1863. Bd. CLXIX., p. 23.

This is a report by Inspector von Legat on Reis' Telephone in its developed form. Inspector von Legat says that this instrument was able to reproduce single words uttered, as in reading and speaking, though not so distinctly as it reproduced chords and melodies, which latter it transmitted with marvelous fidelity. He even added that the inflexions of the voice, the modulations of interrogation, exclamation, wonder, and command attained distinct expression!

So much for Bell's references; Edison's reference is the same as No. 2 of the preceding.

As to the publicity of these documents, permit me to refer you to the shelves of the British museum and other public libraries.

I do not say that there is not plenty of further evidence, were such needed. But here I am quite content to accept the references given by such unimpeachable authorities as Bell and Edison. When they refer me to papers wherein Reis says in substance: "I am the inventor of the telephone. My instrument is intended to transmit human speech and all other kinds of sounds that a human ear can hear, and it succeeds in doing so, though I find, to my disappointment, that it is not yet quite perfect, because, though single words and consonants come through all right, the vowels are not clear." I am bound to believe, on the authority of Bell and Edison, who give me these references, that Reis's modest claim is just. And I am bound to this belief still more strongly because I find, when I make careful trial of Reis's own telephones, that they will do exactly what he said they were intended to do—namely, transmit human speech to a distance by the agency of the galvanic current.

You have, Mr. Editor, most aptly said that the question is, what was *the kind of success aimed at* and attained by Philipp Reis? and I entirely agree with you, that this question is not, in the least degree, affected by whether Philipp Reis is dead or alive. Though himself be dead, and the task of defending his memory from outrage falls to others, his words still live to testify, in the most unmistakable manner, to the aim which he set before himself, and to the measure of success which he attained in his invention of the telephone. Yours, etc., SILVANUS P. THOMPSON.

BRISTOL, March 4, 1883.

P.S.—There is a slight *erratum* in line 12, from bottom of p. 373, where, by mischance, the word which I wrote has been altered from *perfected* to *perfect*. Philipp Reis's telephones of 1862 were not perfect, but were perfected instruments compared with those he showed to the Physical Society in 1861.

THE PROGRESS OF TELEGRAPHY.

ON February 15th, at the Institution of Civil Engineers, Mr. W. H. Preece, F. R. S., delivered a lecture on the above subject, the following abstract of which appears in the London papers:

Telegraphy is the oldest practical application of electricity. It grew about the railway system, and was rendered a practical agent by the foresight of Robert Stephenson, I. K. Brunel, Joseph Locke, and G. P. Bidder, who were its godfathers in England. Electric currents are, as a rule, maintained for telegraphic purposes, by the combustion of zinc; and, in the innumerable forms of batteries in use, the conversion of zinc into sulphate of zinc, is the root of the transformation of energy into that form which was utilized as electric currents. There are three forms of battery in use in the British post office telegraph system, and in the following numbers:

Daniell	87,221 cells.
Leclanché	56,420 "
Bi-chromate	21,846 "

Every administration has its own adopted form, differing in design, but based on one or other of these types. Magneto-electricity is employed for some forms of apparatus, and dynamo machines are sometimes used to supplement batteries. Experiments are now being made with secondary batteries. The various terms employed—electro-motive force, resistance, induction, and current—though measurable in definite units, have not yet become household words; but, being admitted into commercial, legal, and parliamentary lore, they will soon be as familiar as feet, gallons, or pounds.

Electric currents are conveyed from place to place, either overground, underground, or submarine.

OVERGROUND.

Wooden poles, preserved in creosote, are employed in England, but iron poles are extensively used in the colonies. The conducting wire is almost universally of iron, but copper wire is much used through smoky places, where iron is liable to rapid decay. Phosphor-bronze wire is under trial, and is a very promising material, as it possesses the conductivity of copper, with the strength of iron. The improvements made in the quality of iron wire have been very great, and it conducts now fully 50 per cent. better than it did a few years ago. Electric tests have had a marvelous effect upon the production of pure metallic conductors; copper has improved in even greater ratio than iron; samples have been produced, better even than the standard of purity. The insulators remain principally of porcelain, and their forms vary nearly with the number of individuals who use them; the only improvement of any value recently made, is one which facilitates the very necessary process of cleaning.

UNDERGROUND.

Wires are almost invariably carried underground through towns. Copper wire, insulated with gutta-percha, incased in iron pipes, is the material used. There are 12,000 miles of underground wire in the United Kingdom. There is a great outcry for more underground work in England, owing to the destruction to open lines by gales and snowstorms; but underground telegraphs, wire for wire, cost at present about four times as much as overground lines, and their capacity for the conveyance of messages is only one-fourth; so that overground are, commercially, sixteen times better than underground wires. To lay the whole of the post office system underground, would mean an expenditure of about £20,000,000. Hence there is no desire to put wires underground, except in towns. Besides, snowstorms are few and far between, and their effects are much exaggerated. Of the numerous materials and compounds that have been used for insulating purposes, gutta-percha remains the oldest and the best for underground purposes. It, like all other materials used for telegraphy, has been improved vastly through the searching power that the current gives the engineer.

SUBMARINE.

The past ten years has seen the globe covered with a network of cables. Submarine telegraphs have become a solid property. They are laid with facility and recovered with certainty, even in the deepest oceans. Thanks to such expeditions as that of H. M. S. *Challenger*, the floor of the ocean is becoming more familiar than the surface of many continents. There are, at present, 80,000 miles of cable at work, and £30,000,000 have been embarked in their establishment. A fleet of twenty-nine ships is employed in laying, watching and repairing the cables. The Atlantic is spanned by nine cables in working order. The type of cable used has been but very little varied from that first made and laid between Dover and Calais; but the character of the materials, the quality of the copper and the gutta-percha, the breaking strain of the homogeneous iron wire, which has reached 90 tons to the square inch, and the machinery for laying, have received such great advances, that the last cable laid across the Atlantic, by the Telegraph Construction and Maintenance Company, was done in twelve days, without a hitch or stoppage.

Ideas are conveyed to the mind by electric signals, and in telegraphy these signals are produced at distant places, by using two simple electrical effects: 1, that a magnetic needle tends to place itself at right angles to a wire, when an electric current passes through it; and 2, that a piece of iron becomes a magnet when a current of electricity circulates around it. An innumerable quantity of tunes can be played on these two strings. Various companies were established at different times to work certain systems, but when the telegraphs were absorbed by the State, the fittest were selected to survive, and their number consequently declined.

The A B C instrument is the simplest to read, for it indicates the letters of the alphabet by causing a pointer to dwell opposite the desired letter. There are 4,398 in use. Its mechanism is, however, complicated and expensive, and it is being rapidly supplanted by the telephone. The needle instrument is the simplest in construction, but it requires training to work it. There are 3,791 in use in the post office, and 15,702 among different railway companies. As a railway instrument, it is the simplest, cheapest, and most efficient ever devised. The Morse instrument, of which there are 1,330 in use in the post office, and 40,000 on the Continent, records its letters in ink, in dots and dashes on paper tape, and, like the needle and A B C, appeals to the consciousness through the eye; it also indicates the letters of the alphabet by sound, and thus utilizes the organ of hearing. Sound reading is gaining ground in England with great rapidity. There are now 2,000 sounders in use; in 1869 there were none. In America, scarcely any other instrument is used. On the Continent there is scarcely one.

Acoustic reading attains great perfection in Bright's bell instrument, where beats of different sound replace the dot and dash of the Morse alphabet. Sound reading is more rapid and more accurate than any system of visual signals or permanent record. In fact, no record is kept in England, for the paper tape is now destroyed as soon as it has been read. Errors are, of course, inherent in all systems of telegraphy. A telegraphist cannot see what he writes, or hear what he says, and who is there that does not make mistakes whose eye follows his pen, or whose ear takes in his own words? The Hughes' type instrument, which prints messages in bold Roman characters is much used on the Continent; it is, in fact, recognized as the international instrument, but it has had to give way, in England, to a more rapid system of telegraphy. It is, however, solely used for the continental circuits, by the Submarine Telegraph Company. All long cables are worked by Sir William Thomson's beautiful siphon recorder.

In ordinary working, only one message can be sent in one direction at one time; but, by a simple and ingenious contrivance, by which the neutrality of opposite currents is utilized to convey signals, duplex telegraphy is rendered possible, so that two messages can be sent on the same wire at the same time; and, by a still further improvement, where currents of different strength are utilized, four messages are sent on one wire—two simultaneously in opposite directions—at the same time. There are, in England, 319 duplex, and 13 quadruplex circuits at work.

The acme of efficiency in telegraphy is attained in the automatic system, in which manual labor is supplanted by mechanism, in transmitting the messages. There are 71 circuits worked by these instruments, and 224 instruments in use, and a speed of working of 200 words per minute, is easily maintained upon them. When the hand alone is used, from 30 to 40 words per minute is the maximum rate attained, but by automatic means the limit is scarcely known. Since this system can be duplexed, and in many cases is so, 400 words per minute on one wire are easily sent. By the use of high speed repeaters, the length of circuit for automatic working is scarcely limited; it would be easy to send 100 words per minute to India.

The growth of business since the telegraphs have been acquired by the State is enormous; 126,000 messages per week have grown to an average of 603,000; but the mileage of wire has not increased in anything like the same proportion, the excess of traffic having been provided for by the great improvements made in the working capacity of the apparatus. In 1873, the average number of messages per mile of wire was 147, it is now 256. It is in press work that the greatest increase has taken place; 5000 words per day at the time of the companies have grown to 934,154 words per day now. 340,966,344 words of press matter were delivered in the year ending March 31, 1882.

The development of railways has necessitated a corresponding increase in the telegraphs required to insure the safety of the traveling public, and while 27,000 miles of wire in England, Scotland, and Wales were used for that purpose in 1869, at the end of December, 1882, the total had increased to 69,000 miles, equipped with 43,176 instruments, against 8,678 in 1869.

The growth of business is equally discernible in the great cable companies. In 1871, the number of messages dealt with by the Eastern Telegraph Company was 186,000; in 1881, it was 720,000. This growth is equally striking in all civilized countries, and even in Japan 2,223,214 messages were despatched last year, of which 98 per cent. were in the native tongue. The mode of transacting the trade of the world has been revolutionized; and while wars have been rendered less possible, their conduct has been expedited, and their penalties alleviated.

—— A WASHINGTON DESPATCH says: Interesting and important developments are expected as the result of the pending cross-examination of Prof. Alexander Graham Bell, in the case of the People's Telephone Company and the American Bell Telephone Company. This particular suit was brought in 1880, and the expectation is, that it will be argued before Judge Wallace, of the United States District Court for the Southern District of New York, during the coming autumn. The American Bell Telephone Company is represented by its counsel, Mr. J. J. Storrow, of Boston. The People's Telephone Company is represented by Lysander Hill, of Chicago, with Park Benjamin, of New York, as expert counsel. Prof. Bell was examined in this case a year or two ago, but never cross-examined. The cross-examination was delayed by one cause and another, until this winter. When the time came for cross-examination, Prof. Bell was not able, on account of the illness of a child, to leave Washington, so the lawyers came here. One of the parlors in Prof. Bell's handsome new house, has been transformed into a temporary court room. There the counsel meet, almost every day and night, and propound the questions they have prepared. The cross-examination is expected to end soon. The points the counsel for defendant are trying to establish they, of course, decline to make public. But, as a matter of public interest, they say, this is the first time that any examination was ever held which would have the effect of bringing out all the details of the invention of the telephone. Prof. Bell is simply telling, in response to these cross-interrogatories, the story of his invention. The People's Company, it will be remembered, claims that Daniel Drawbaugh, of Harrisburg, Pa., is the original inventor of the telephone, and that it can prove by scores of witnesses, that he operated a telephone, embodying all the principles of the Bell telephone, six years before Bell applied for a patent.

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WE call attention, in another column, to the first of a series of articles on "Steam Engines for Electric Lighting Plant," from the pen of Professor Robert H. Thurston, of Stevens's Institute of Technology. Professor Thurston's experience in the construction and management of engines and machinery, his reputation as a student of mechanical science, and the fact that his subject is, at present, engaging the attention of scientists here and abroad, and that the development of the steam engine is, to a certain extent, that of the world's progress, will cause general interest in his writings; and they will, doubtless, be read with avidity by the fellow members of the leading scientific societies to which he belongs, among which are the American Society of Mechanical Engineers, of which he was president, the American Institute of Mining Engineers, the Institution of Engineers and Ship Builders of Scotland, the British Institution of Naval Architects, and the Academy of Science.

THE PROSPECTS OF ELECTRIC LIGHTING.

RAPID transportation, in shortening unavailable time, and artificial light in lengthening available time, minister to the necessities of commercial and home life; and, very naturally, form our greatest industries. Twenty per cent. of the business capital in the United States is invested in railways, and the next leading industry is the production of artificial light; and, although we are not aware of any comprehensive statistics on the subject, we think it may be roughly estimated at something more than one per cent. of the business capital.

When one considers the immense resources of the corporations manufacturing gas, and of the petroleum refining interests, and also the great length of time and enormous outlay which have been necessary for bringing gas lighting and lighting by oil to their present state of convenience and efficiency, it is surprising how rapid have been the advances of the electric light.

The problem of the future of electric lighting involves many interests. Enough capital has been invested in this enterprise, to render its stability a matter of importance to the financial world; while those who have invested in electric lighting await the ultimate result of their undertaking. The public recognizing the general advantages of the new system of illumination, awaits with impatience its perfection and general introduction. To some inventors, heart-weary with hope deferred, the success of some particular system represents the height of human ambition; and the young man about to choose a vocation, has to consider whether the promise of the ultimate growth of electric lighting offers to him that opportunity which, "If taken at the flood, leads on to fortune."

Only four or five years have elapsed since the first commercial introduction of the arc light in this country, and hardly two years since the incandescent light was first brought before us in practical form.

At the present time, the electric light repels the gloom of night in every important city of the Union. The experience of its use in mills has demonstrated its superiority for such use to other methods of illumination, both in respect to economy, and in respect to the absence of excessive heat, and deleterious products of combustion which enervate the employees; and the advantages from this cause, and the more thorough illumination attainable, add to quantity and quality of the manufactured product. In stores, the value of the electric light in exhibiting goods at their best advantage would warrant its use, even if other considerations were disregarded. Wherever a better, purer, and stronger light was desired, there, electricity has been able to fill the demand.

This has been accomplished in the face of enormous difficulties. When the commercial manufacture of electric lighting apparatus commenced, it was a business without precedents; everything being new, crude, and undeveloped. No trained assistants were available; the books on electricity contained nothing upon the modern use of heavy electric currents; the scientific schools taught little of value; telegraphy had little in common with the subject, beyond a few general principles, so that neither technical graduates, nor telegraphers, were prepared to enter upon electric lighting work without further training. Mechanics had much to learn in matters of construction of apparatus; the proper manufacturing supplies were not in the market; and even engines, most suitable for driving dynamo machines, had to be invented. The development of the whole business, from the least unto the greatest, required invention, education, and organization.

The general business of electric lighting has not been without errors. A mistake, which is deplored by all who have any interest in the prosperity of electric lighting, has been the undue extent to which the business has been involved in speculation upon fictitious valuations of patents. Instead of firms, or corporations, wherein the inventor and the capitalist could place the joint product of their brains—mechanism and money—upon an equitable basis, the speculator has come in with pernicious schemes of amplified capital stock.

"You may put me down for one of the ciphers, and then there will remain only five hundred dollars to raise," said the late Isaac O. Barnes, to the elder who bore a subscription paper for the purpose of raising $5,000 to pay off the debt of the Mount Zion (colored) Church. "Dis yer firgurins all 'krect, but whar's the dollars?" said the elder, after an interval. In numerous instances of electric light enterprises, so many have *subscribed to the ciphers*, that comparatively few dollars have been left for the prosecution of the business. In England, this matter has been carried to a ruinous extent, where capitalization has been forced to a point far beyond that justified by any judicious estimate of the prospects for business.

The first effect of the introduction of the electric light upon the gas companies was civility, and the second, prosperity.

The brilliant illumination produced by electricity, has quickened the demand for more light, and consumption of gas has been increased wherever electric lights have been used.

When electric lights were first introduced in the streets of New York, much fear of the new rival was expressed at the director:' meeting of a gas company. One of the heaviest stockholders said, that as long as electricity remained in the street and did not enter the houses, their resistance must be very passive ; and facts were presented showing, that when a certain street was lighted with electricity, a neighboring hotel, unwilling that its gas lights should appear so dim, removed its gas regulator, and thereby increased its consumption of gas about twenty per cent.

It has been claimed that electricity will supersede gas; but no extension of a perfect light would accomplish such a result immediately, or without a hard struggle.

It is no disparagement to electricity to state, that the electric light has not caused the removal of a single gas meter, if it can also be proven that it has created an increased demand for illumination sufficiently great to warrant the introduction of electric lighting. It is well-known, that the consumption of gas has increased wherever electric lights have been used. The presence of the more powerful light produces a demand for better illumination elsewhere.

It is not considered that the use of kerosene has entailed any severe hardship upon the gas companies, because kerosene is used where gas is out of the question, and very rarely because it is cheaper. Because the field for electric lighting is very large, it is not boundless. The limits cannot be stated at the present time, but they will be as well defined as those between gas and kerosene. As more is learned by experience concerning the details of its application, dangers will be obviated, prejudices will be overcome, and the uses of the electric light will be multiplied. When the Houses of Parliament, in London, were built, the architect's specifications required that no wood-work should approach within six inches of the gas pipes.

Lighting is but one of the purposes for which electric currents are available. Electricity is energy, and the light is merely the result of the conversion of this energy into heat. Electrical energy is also convertible into mechanical work ; and whenever any satisfactory electric-motor fitted for a wide range of duties, is introduced to the public, then there will be a demand for electricity for domestic uses, in addition to the numerous minor industries which require small powers.

If the motor was at hand, it would be used for pumping water, running sewing machines, dumb waiters, ventilating apparatus, and many domestic purposes for which there is now no motor, and really little demand.

The introduction of such improvements, require time for the general public to be educated to the appreciation of the convenience of such a convenient and safe motor in the house.

Some persons are in expectation of improvements in electric light apparatus, which will diminish the power required one-half, or some equally impossible reduction. There is not room for much economy in this direction. The dynamo machine approaches more nearly to theoretical perfection than any other machine known to mechanics.

The most serious obstacle to the economical generation of electricity by dynamo machines, is the extremely low efficiency of the steam engine as a means of converting heat into mechanical work.

We may commiserate the poor native, in the interior of Africa, who traps an elephant, starves the brute, and carries his tusks to the next tribe, where it is passed along in turn to the seaboard. Once sold for the quota of rum, beads and calico, the last messenger drinks the rum for his services, and passes the beads and calico to the man who gave him the tusks, and each one appropriates a share for his work, until the poor fellow who obtained the tusks, finally receives hardly enough cloth to remind him of the sin of Eden, and a necklace of beads for his favorite wife.

Yet we make a similar transaction in the operation of every steam engine and boiler. A steam engine supplied with steam from a boiler which evaporates eight pounds of water for every pound of coal consumed, and requires three or four pounds of coal per horse power per hour, represents the operation of a well arranged boiler and non-condensing steam engine. The combustion of each pound of fuel produces a chemical change, which develops a certain amount of heat; but the boiler and its setting levy a toll of about thirty per cent. of this amount, for services in generating the steam. The steam passes to the engine cylinder, but the services of only a part of the steam are accepted and converted into work, the rest being used to warm the cylinder, or blown out of the exhaust as contemptuously as salt without savor. But the work is in the cylinder of the engine, and is not available for use, and allowance still has to be made for friction and other losses.

After making proper deductions for all these losses, probably not more than ten per cent of the theoretical energy of the fuel is finally available for driving the dynamo. It has been stated by mechanical engineers of the highest authority, that the best compound condensing engines of very large size do not show a higher efficiency than from fifteen to eighteen per cent.

Evidently, if some method could be devised for generating electricity from heat directly, which would avoid any considerable part of this enormous waste of energy, a great advance would be made, which would give electric lighting possession of almost the entire field of artificial illumination, and make the electric motor a formidable competitor of the steam engine, as a prime mover, wherever mechanical power is used. It is possible that a discovery may be made which will realize this, but we see no indications which point to the direction from which it may be expected. Experiments with the thermo-pile have not proved encouraging, and although other forms of generator have been suggested, none of them seem to promise practical results immediately.

In the meantime we must rest content with the dynamo machine, and use the best mechanical power attainable for driving it.

But, while we may not look for any great improvement of present dynamos in the direction of greater economy of power, we may reasonably expect considerable simplification of construction and reduction of cost. Other parts of the apparatus will also undoubtedly be greatly improved in efficiency, and their cost will be reduced and many accessories and minor appliances will be added to existing systems, from time to time, which will greatly increase their efficiency, safety, and convenience in general use.

The extension of the central station system will undoubtedly constitute the great future of electric lighting. In this we may reasonably expect very great reduction in operating expenses, from the adoption of improved apparatus and better systems of distribution and regulation, the employment of cheaper labor in construction and attendance, and from greater experience in the details of management.

With the reduction of cost will come increased demand and a larger extension of the business.

As it stands to-day on the work it is doing, and its proven capabilities, electric lighting rests on a prosperous basis, with brilliant prospects for the future.

—— THE LATEST THEORIES concerning the sun, consider that it gives forth energy, which appears as heat, light, or electricity, according to the medium which absorbs this energy. There are astronomical phenomena, especially those in connection with the divers directions taken by the tails of comets, which can be satisfactorily accounted for only on the hypothesis of electrical action, which is supposed to pervade the inter-planetary spaces. The electricity in the sun is of opposite polarity to that of space.

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY PROFESSOR ROBERT H. THURSTON

I.—HISTORICAL—THE DEVELOPMENT OF THE STEAM ENGINE.

THE growth of the steam engine into the forms now familiar to everyone who takes the slightest interest in this most important of modern mechanisms, has occurred by a series of transitions which is easily traced, and which is especially interesting to every thoughtful mechanic as representing the steps in a steady progression, toward ideal perfection, of which the end is not yet seen.

A century ago, James Watt had just begun to introduce the first engines belonging to a, then, new type.[1] A century before (1698), the ingenuity and practical skill of Captain Savery, had conferred an enormous benefit upon the mining industries, and through them upon the world, by applying the "fire engine" of the Marquis of Worcester to raising water from the then rapidly deepening mines.[2] Savery used steam of 8 to 10 atmospheres (120 to 150 pounds) total pressure, in some cases,and he is entitled to fame as the first to introduce that now familiar concomitant of civilization, the steam boiler explosion. The usual pressure was 3 atmospheres. These engines demanded about 30 pounds of coal, per horse-power per hour, as a minimum. The apparatus of Savery was not what would to-day be called a steam engine, at all. It was not a train of mechanism, involving moving parts, cylinder, piston, crank and fly-wheel, but either a single pair of closed vessels, or three vessels, one of which was a boiler, and the other, or others, metal chambers of spherical, cylindrical, or ellipsoidal form, which were at once condensers and pumps. The latter were filled with steam, which being condensed, the water rose into, and filled them, and was then forced out by a succeeding charge of steam, of pressure exceeding that of the head against which the lift took place. Huyghens (1680), and Papin (1690), proposed true engines with steam pistons traversing their cylinders, and forming, on the whole, much such a train of mechanism as is now so well known[3]; but the Newcomen engine was the first of this type to come into practical use. This machine, then called the "Atmospheric Steam Engine," consisted of a steam cylinder, with a piston taking steam beneath, the upper end of the cylinder being open to the atmosphere, the piston actuating a "working beam," or "walking beam," and, through the latter, working pumps attached to the opposite end. Neither crank, shaft, nor fly-wheel was used; the action of the engine was controlled entirely by the adjustment of its valves. In its operation, steam at a little higher than atmospheric pressure, was admitted below the piston; the weight at the pump end depressed that extremity of the beam, raising the piston. The steam below the piston was then condensed by a jet of water thrown into the cylinder, producing a vacuum; and atmospheric pressure, finally forced the piston down, raising the pump-rod and plungers. The weight on the latter was adjusted to the work, so that, when steam was admitted, this weight should force the pumps to discharge the water. The only function of the steam was the displacement of the atmosphere, or counter balancing it, by entering below the piston, and thus permitting the formation of a vacuum. A writer of that time states[4] that "Mr. Newcomen's invention of the fire engine, enabled us to sink our mines to twice the depth we could formerly do, by any other machinery"; but "every fire engine of magnitude consumes £3,000 worth of coal per annum." The coal consumption was, at best, about 20 pounds per hour and per horse-power. Smeaton, the greatest civil engineer of his time, put up many of these engines in Holland and elsewhere, as well as in Great Britain; some were 66 inches in diameter of cylinder, and 8 to 9 feet stroke of piston. It was this engine that Watt found in operation, when he entered upon the stage.

Watt was not simply a mechanic; he was a real philosopher, and a truly scientific investigator. A model Newcomen engine, having been brought to him to be repaired, he took advantage of the opportunity to study the principles of its construction, to ascertain its defects, and to devise proper remedies. He found that the sources of loss were the conductivity, and radiating power of the steam cylinder, the alternate heating and cooling of the metal at each stroke, the imperfect vacuum, and the wastes from boiler and steam pipes. To correct these defects, he clothed his boilers and steam pipes with non-conductors, sometimes, even making boiler shells of wood. Smeaton had already covered the pistons and cylinder heads with wood. Watt made a small wooden steam cylinder, and obtained great economy; he made a more practicable improvement, however, when he devised the steam jacket. He attached a separate condenser to prevent the loss due to the introduction of condensing water into the steam cylinder, closed the cylinder at the top, made the engine double-acting, and finally, adapted the engine drive machinery, fitting it with shaft and fly-wheel, throttle valve, and governor, and thus making the steam engine such as we see it to-day, in all essential particulars, not excepting the steam jacket, and the arrangement, of its valve gear to secure economy by the expansion of the steam. His engine was substantially complete by the year 1784.[5]

Later changes have been a succession of refinements, and of developments in application. Stephenson, and his contemporaries, applied steam on railroads; Stevens, Fitch, and Evans, and, finally, Fulton, in the United States, and Bell and others, in Europe, introduced steam navigation; Sickels invented the "detachable" cut-off valve gear; Corliss introduced the peculiar type of engine that has given him a world-wide fame, and so attached its governor as to determine the point of cut-off automatically, and thus to regulate the engine; and, a little earlier, Robert L. and Francis B. Stevens designed the American river steamboat, and its beam engine, with so simple and effective a valve gear that it remains, to-day, still standard. The compound engine, even, was brought out by contemporaries of Watt, and thus every prominent feature and essential detail of the modern steam engine was introduced at, or before, the beginning of the nineteenth century.

Yet, practice has been steadily changing during the century, and the form and proportions of the steam engine, and the methods of steam distribution, have been undergoing constant changes. In the time of Watt, steam was worked at about 7 pounds pressure, per square inch, in stationary engines; they were always fitted with condenser and air-pump, and were slow in movement, and were, consequently, of small power in proportion to their size; they wasted heat and fuel to such an extent, as to demand 6 or 8 pounds of coal per horse-power and per hour. It is true that Wolff, in 1804, expanded 6 or 8 times, using higher steam and obtained the horse-power with 4 pounds of fuel per hour, and that John Stevens and Oliver Evans, in the United States, and Trevithick, in Great Britain, had already used still higher steam in non-condensing engines; but these examples simply illustrated the fact, now familiar to every student of philosophical history, as pictured by Draper, Buckle and

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[1] History of the Growth of the Steam Engine. International Series. N. Y., D. Appleton & Co.

[2] The writer finds this engine described in Harris's "*Lexicon Technicum*," of 1704, of which, now rare work, he is so fortunate as to possess a copy.

[3] Mem. Acad. Sci. Paris, 1680. Acta Eruditorum. Leipsic, 1690.

[4] *Mineralogia Cornubiensis.* Price. 1778. Appendix.

[5] History of the Growth of the Steam Engine. P. 119.

Leckey, that isolated examples which lead standard practice by a half century or more, are to be observed during the growth of every art. Recognized standard practice is always as conservative as it is permitted to be by trade competition, and usually changes very slowly. Principles may be discovered and understood, and a correct theory of design and of practice may be made generally familiar, and often is, in a brief period; but the growth of application and the familiarizing of constructors and operatives with new mechanisms, and new methods of management, requires time, and is slow at best. Thus it has happened, that although the principles of steam engine economy were, in the main, well understood by James Watt, and some of his competitors, nearly a century ago, and have become well settled in later years, we are still far from a completely satisfactory solution of the problem, which, as stated by the writer elsewhere* may be enunciated thus:—" To construct a machine which shall, in the most perfect manner possible, convert the energy of heat into mechanical power, the heat being derived from the combustion of fuel, and steam being the receiver and conveyer of that heat."

EQUIVALENTS OF ELECTRICAL AND MECHANICAL ENERGY.

As electricity is now produced in such large quantities by mechanical powers, it is often required to calculate the amount of electricity which corresponds to a given power; or, in the case of electrical motors, the amount of power which corresponds to a given electric current. To facilitate such calculations, the following tables were calculated. They give the values of the electrical units of energy, in terms of all the mechanical units of energy used in this country, England, France, and Germany ; and the values of all these mechanical units, in terms of the electrical units.

Before proceeding to explain the tables and the basis on which they are calculated, it may be well to call attention to a distinction, between the two forms of expressing mechanical energy, *work* and *power*. *Work* depends on the weight lifted, and the distance through which it is lifted, or, in more general terms, the force acting, and the distance through which it acts; it is, therefore, independent of *time*. *Power* is work done in a certain time ; and, therefore, depends on time, as well as weight and distance. To express this in a formula—

$$\text{power x time} = \text{work}$$

therefore

$$\frac{\text{work}}{\text{time}} = \text{power.}$$

For instance—

2 horse-power for 10 minutes = 660,000 ft. lbs.

$$\frac{660{,}000 \text{ ft. lbs.}}{10 \text{ min.}} = 2 \text{ horse-power.}$$

Heat, being only another form of work, is included in the general term *work*.

The units, in terms of which an electrical current, or electrical energy, is given, are—

Ampére—the unit of current strength—generally represented by C.

Volt—the unit of electro-motive force—generally represented by E.

Ohm—the unit of resistance—generally represented by R.

Coulomb—the unit of quantity—generally represented by Q.

In order to calculate these tables, it was necessary to have some one equivalent between an electrical unit of energy, and a mechanical unit of energy, all the others being readily calculated from this one. This equivalent was calculated in the following way. As two quantities of like electricity repel each other, work is done by moving a quantity of electricity toward another quantity, against the repelling force ; that is, moving it through a difference of potential, or against an electro-motive force. If the electro-motive force moves the electricity, work is done by the current. Therefore—

$$\text{work} = \text{electro-motive force x quantity;}$$

or, using W to express the work of the current—

$$W = E\,Q.$$

As mechanical work is generally given in foot-pounds or in kilogrammetres, E in volts, and Q in coulombs, it is necessary, in order to get some numerical relations between them, to reduce them all to the same units. This can readily be done by the *C. G. S.* system of units. In this system :

1 absolute unit of work = 1 absolute unit of electro-motive force x 1 absolute unit of quantity. (1)

1 absolute unit of work = 1 erg. (2)

1 volt = 10^8 absolute units of electro-motive force.

1 coulomb = $\frac{1}{10}$ absolute unit of quantity.

Therefore—

$$1 \text{ absolute unit of electro-motive force} = \frac{1 \text{ volt}}{10^8} \quad (3)$$

$$1 \text{ absolute unit of quantity} = \frac{1 \text{ coulomb}}{\frac{1}{10}} = 10 \text{ coulombs.} \quad (4)$$

Substituting the values from (2), (3), and (4), in equation (1)

$$1 \text{ erg} = \frac{1 \text{ volt}}{10^8} \text{x } 10 \text{ coulombs.}$$

From which

$$1 \text{ volt-coulomb} = 10^7 \text{ ergs.} \quad (5)$$

An erg is the amount of work done by a force of 1 dyne, acting through 1 centimetre, that is—

$$1 \text{ erg} = 1 \text{ dyne x } 1 \text{ centimetre.}$$

A gram is $= g$ dynes (g = acceleration of gravity).

therefore, $$1 \text{ dyne} = \frac{1 \text{ gram}}{g}$$

and $$1 \text{ erg} = \frac{1 \text{ gram}}{g} \text{ x } 1 \text{ centimetre.}$$

Substituting this value in (5),

$$1 \text{ volt-coulomb} = \frac{10^7}{g} \text{ gram centimetre.}$$

Taking the mean value of $g = 981$,

$$1 \text{ volt-coulomb} = 10193.679 \text{ centimetre grams.}$$

As centimetre grams are readily reduced to foot-pounds, heat-units, horse-powers, etc., this equation is the basis on which the tables were calculated.

As almost all the equivalents are incommensurable, it would be troublesome to divide them into a number ; for this reason, the reciprocals of all these numbers have been calculated; so that all calculations can be made by a single multiplication. As a volt-coulomb is a volt-ampére per second, the two are interchangeable, the one representing work, the other (volt-ampére) power. When the electro-motive force in volts and the current strength in ampéres is given, the power of the current in volt-ampéres is of course equal to their product. But when the current strength and the resistance of the circuit are given, the power in volt-ampéres is C^2R, in which C is the current strength in ampéres, and R the resistance of the circuit in ohms. Similarly, if the resistance and the electro motive force are given, the power in volt-ampéres, is $\frac{E^2}{R}$, in which E is the electro-motive force in volts, and *R*, the resistance in ohms.

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* Ibid. P. 466.

These tables give the *actual* equivalents, and, therefore, do not take into account the loss in converting one kind of energy into another, as that is dependent upon the particular machine used.

EQUIVALENTS OF WORK.

			Logarithm.
1 volt-coulomb =	1.0000000	volt-ampére per second	0 0000000
	.737324	foot-pounds	$\bar{1}$.8676580
	.101937	kilogrammetres	$\bar{1}$.0083310
	.00095508	pound-Fahr. unit of heat	$\bar{4}$.9800407
	.00053060	pound-centigrade "	$\bar{4}$.7247682
	.00024067	kilogr.-centigrade "	$\bar{4}$.3814342
	.00134059	horse-power per second	$\bar{3}$.1272954
	.000022343	" per minute	$\bar{5}$ 3491441
	.00135916	force-de-cheval* per sec.	$\bar{3}$.1332698
	.0000226526	" per min.	$\bar{3}$.3551185
1 volt-ampére per sec. =	1.0000000	volt-coulomb	0.0000000
1 foot-pound =	1.35626	volt-coulombs	.1323420
1 kilogrammetre =	9.810000	"	.9916690
1 pound-Fahr. unit of heat =	1047.030	"	3.0199593
1 pound-centigrade " =	1884 655	"	3.2752318
1 kilogr.-centigrade " =	4154.950	"	3 6185658
1 horse-power per second =	745.941	"	2.8727046
" per minute =	44756.47	"	4.6508559
1 force-de-cheval* per sec. =	735.750	"	2 8667302
" per min. =	44145.00	"	4 6448815

EQUIVALENTS OF POWER.

			Logarithm.
1 volt-ampére =	1.00000	volt-coulomb per second	0.0000000
	.00134059	horse-power	$\bar{3}$.1272954
	.00135916	force-de-cheval*	$\bar{3}$.1332698
	.737324	foot-pounds per second	$\bar{1}$.8676580
	44 23944	" per minute	1.6458093
	2654.3664	" per hour	3 4239606
	.101937	kilogrammetres per sec.	$\bar{1}$.0083310
	6.11622	" per min.	.7864823
	366 9732	" per hour	2.5646336
	.00095508	pound-Fahr units of heat per sec.	$\bar{4}$ 9800407
	.0573048	" per min.	$\bar{2}$.7581920
	3 438288	" per hour	.5363433
	.00053060	pound-centigrade units of heat per sec.	$\bar{4}$.7247682
	.0318360	" per min.	$\bar{2}$.5029195
	1.910160	" per hour	.2810708
	.000240670	kilogram-centigrade units of heat per sec.	$\bar{4}$.3814342
	.0144402	" per min.	$\bar{2}$.1595855
	.866412	" per hour	$\bar{1}$.9377368
1 volt-coulomb per sec. =	1.000000	volt-ampére	0.0000000
1 horse-power =	745.941	volt-ampéres	2.8727046
1 force-de-cheval* =	735.750	"	2.8667302
1 foot-pound per sec. =	1.35626	"	.1323420
" per min. =	.0226043	"	$\bar{2}$.3541907
" per hour =	.000376738o	"	$\bar{4}$ 5760394
1 kilogrammetre per sec. =	9.8100000	"	.9916690
" per min. =	.163500	"	$\bar{1}$.2135177
" per hour =	.00272500	"	$\bar{3}$.4353664
1 pound-Fahrenheit unit of heat per sec. =	1047.030	"	3 0199593
" per min. =	17.4505	"	1.2418080
" per hour =	.290842	"	$\bar{1}$.4636567
1 pound-centigrade unit of heat per sec. =	1884.655	"	3.2752318
" per min. =	31.41091	"	1.4970805
" per hour =	.523515	"	$\bar{1}$.7189292
1 kilogram-centigrade unit of heat per sec. =	4154.950	"	3.6185658
" per min. =	69.2492	"	1.8404145
" per hour =	1.154153	"	.0622632

The following examples will illustrate the use of the foregoing tables.

I. How many incandescent lamps, requiring an electromotive force of 60 volts and a current of 1.5 ampéres each, can be supplied by an engine giving 15 useful h. p.?

If the loss of energy in the dynamo is 20 per cent., then 80 per cent. of 15. = 12 will be the h. p. of current available. From the tables, 1 h. p. = 746 volt-ampéres; 1 lamp requires 1.5 x 60 = 90 volt-ampéres; therefore,

$$\frac{12 \times 746}{90} = 100 \text{ lamps very nearly.}$$

II. What h. p. is required to supply 100 lamps of 40 ohms resistance each, requiring an electro-motive force of 60 volts?

The number of volt-ampéres for each lamp is $\frac{E^2}{R} = \frac{60^2}{40}$

From the tables, 1 volt-ampére = .00134 h. p.; therefore,

$$\frac{60^2}{40} \times 100 \times .00134 = 12 \text{ h. p. very nearly.}$$

If the loss in the dynamo is 20 per cent., then 12 h. p. is 80 per cent. of the actual h. p. required; therefore,

$$\frac{12}{.80} = 15 \text{ h. p.}$$

C. O. HERING,
University of Penna.

PHILA., March 21st, 1883.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(Continued from Page 77.)

THE UNIVERSAL STOCK PRINTER.

THIS instrument is one of the earlier inventions of Thomas A. Edison, and was produced by him for the Gold and Stock Telegraph Company, to perform the same functions on two wires, as the Calahan instrument performs on three wires. The peculiar device by which the saving of one wire is secured is called the "shifting type-wheel," by means of which either one of two type-wheels may be printed from at the will of the operator. Both of the type-wheels are controlled by one wire.

The construction of this instrument was also designed with a view to avoiding the faults of the earlier three-wire machine, as shown by the carefully kept records of complaints arising from the daily service of the large number of instruments which were soon put into actual use. Another great stride toward perfection in construction consisted of a feature, which was first applied to printing telegraph instruments by this inventor, viz.: the inter-changeability of the parts, which were made to gauge. Although this endeavor was not always rigidly carried out, on account of the expense and difficulty attending application of the principle to minor details, it was nevertheless adopted to a considerable extent. On account of its simplicity of design, electrically (it uses no principles that are not employed in the ordinary Morse sounder), as well as for economy in making installations, the instrument has always been a great favorite with the Company, for use in its branch systems in provincial cities. The fact that the Company had already made and introduced a large number of the three-wire instruments in this city before the universal instrument was invented, has prevented any extensive use of them in New York city, and there are now only about 100 of them in use here, principally on Petroleum and Mining Quotation circuits. Under the same electrical conditions, the speed of this machine is slightly faster than that of the three-wire machine, for which difference it is indebted to the more favorable form and arrangement of the escape-wheel and escapement anchor.

The form of transmitter originally designed for this machine, was never perfected by the inventor, who turned his attention to the subject of automatic telegraphy, before he had fully developed his ideas in the former field. The transmitting apparatus has, however, subsequently been much improved and perfected by Mr. George B. Scott, the Superintendent of the Company, and has now attained a high degree of reliability, with the great simplicity of construction. The receiving instrument is shown in full in Fig. 1, while Figs. 2 and 3 give details of the peculiar distinctive features of the machine.

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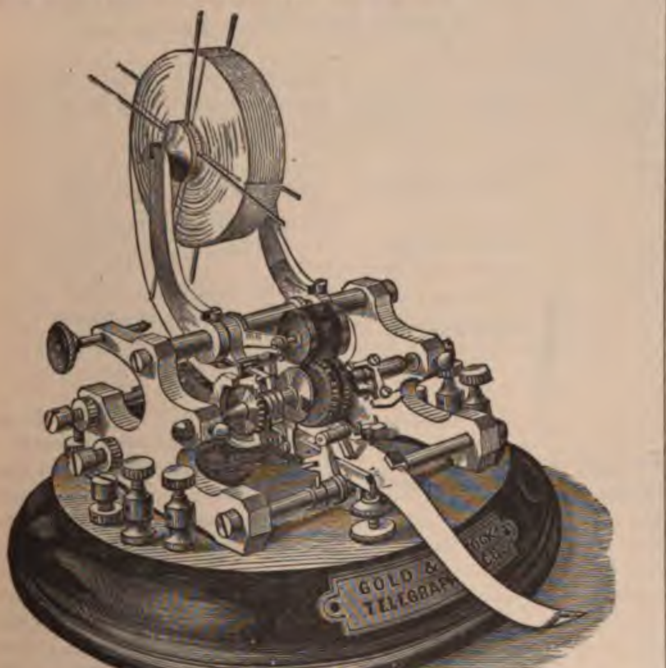
* 1 force-de cheval or French horse-power = 75 kilogrammetres per second.

The receiving instrument can be best described in four parts: *First*, the printing and feeding mechanism, operated by the press-wire; *Second*, the type-wheels and their accessories operated by the type-wire; *Third*, the unison device; *Fourth*, the shifting apparatus. The last two portions are operated by actions resulting from the operations of both wires combined.

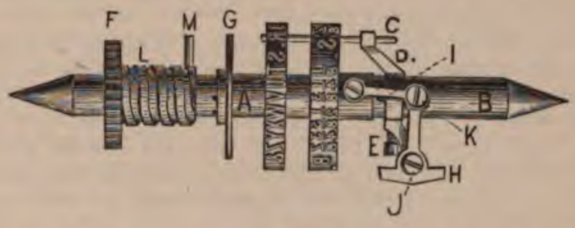
The type-wheels are rigidly fixed, side by side, on a moveable sleeve or tube, Fig. 2, A, which may be slid lengthwise on the escape-wheel shaft, B. The type-wheel sleeve with the type-wheels attached, is, however, forced to revolve with the escape-wheel shaft when the latter rotates, by a guide pin C, projecting at right angles to the line of motion, and fastened to both type-wheels, and which passes through a slot in an arm D, which is rigidly fastened to the escape-wheel shaft by the screw E passing through a band or collar which encircles the shaft B.

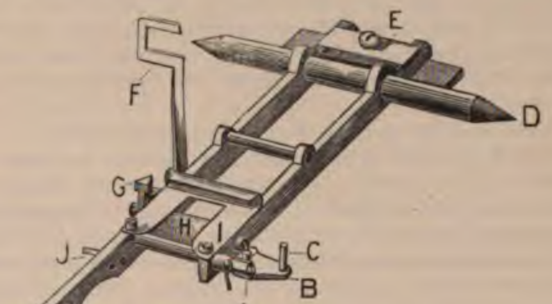
An electro-magnet in the circuit of the type-wire, vibrates an armature carrying an anchor, which rotates a 15-toothed escape-wheel F, rigidly fixed on the escape-wheel shaft. The type-wheels each carry 30 characters, and 15 pulsations of the current, together with 15 actions of the retracting spring on the type armature, revolve the type-wheels once.

A single inking wheel, formed of discs of cloth laid side-by-side on a central shaft, and clamped together by end discs of ebonite, revolves on a spindle within a frame, which allows the inking wheel to rest on the type-wheels, and to revolve with them by friction.



Rigidly fastened on the same sleeve as the type-wheels, and a little to the left of the letter type-wheel, is a disc of the same diameter as the type-wheels, called the lock-wheel, (see G, Fig. 2). This disc has a notch in that portion of its periphery, which is in line with the space filled by both of the dots on the letter and figure type-wheels. These dots are not in line however, one being a character in advance of the other, in respect of a line drawn through both wheels at right angles to their plane of motion. The notch in the disc G, is as wide as the transverse space occupied by both of these dots, and when either of these two dots are opposite the paper, in a position to be printed from, the notch in the disc G, is opposite an upright arm with a wedge-shaped head (see G, Fig. 3), which projects upward from the press lever. The type-wheels may then be shifted transversely on the escape-wheel shaft; but in all other positions of the type-wheels, the wedge G, Fig 3, is in the path of any attempted lateral movement of the disc G, Fig. 2, and thus prevents any accidental movement of the type-wheels from the position they have been intentionally placed in by the operator; thus ensuring the rotation of the type-wheels in the same plane, at all parts of the revolution. For effecting printing from either of the two type-wheels at will, the type-wheel sleeve, A, Fig. 2, is provided with a pivoted T shaped lever H, having an arm I, extending at right angles therefrom, and fastened at its further extremity to the type-wheel sleeve. The T lever and arm have two pivots, one at J and one at K. Now, if the right-hand arm of the T piece H, be tilted upward, the type-wheel sleeve A, together with the type-wheels and slotted disc G, will be pushed to the left until the sleeve is stopped by the shoulder of the unison worm L, and the unison pin M.; provided the slot in the disc G is in a position to allow the wedge piece G, Fig. 3, to pass through. In this position the figure type-wheel will be vertically opposite the right hand margin of the band of paper, and the letter type-wheel will be immediately opposite the left hand rim of a thin flexible brass shield I, Fig. 3, which prevents the letter-types from touching the left hand margin of the paper.





On the other hand, if the left-hand arm of T piece H, be tilted upward, the type-wheel sleeve and its accessories will be carried to the right-hand, until stopped by the type-wheel sleeve touching the collar supporting guide-pin arm D. In this position the letter-types will be opposite the left-hand margin of the paper, and the figure-types will be above the right-hand rim of shield I, Fig. 3, which will prevent them from touching the paper.

The devices which enable the operator to shift the type-wheels are as follows: Fig. 3, shows the press-lever and its attachments. Two keys in the transmitter correspond in relative position to two dots, one on the letter type-wheel and one on the figure type-wheel, the latter being one tooth of the escape-wheel ahead of the former. The keys on the transmitter represent either letters or figures interchangeably, and there is but one bank of 30 keys for the 60 characters. When the first dot of the letter type-wheel, is brought opposite the paper with the slot in disc G, Fig. 2, opposite the wedge G, Fig. 3, and the letter dot key of the transmitter depressed, the press-lever comes up, bringing pin A, Fig. 3, on the plate B, of the press-lever, under the left-hand arm of the pivoted T lever H, Fig. 2. The type-wheels are pushed to the right as before described, and the letter-types are in position to be printed from indefinitely, since neither a continued rotation of the type-wheel, nor movements of the press-lever to take impressions therefrom, can move the type-wheels transversely. But if the operator desires to print from the figure type-wheel, he depresses the figure dot key, which stops the type-wheel with the figure dot opposite the shield and the slot in disc G, Fig. 2, opposite the wedge G, in Fig. 3. The upward movement of the press-lever brings the right-hand pin C, Fig. 3, under the right-hand arm of T lever H, Fig. 2, when the latter is tilted to the left and the type-wheels slid over to the left-hand with the figures opposite the paper, as before described.

In Fig. 3, D is the press-lever shaft and pivots, E the armature, F the unison-tripper, G the wedge piece, H the printing pad, I the flexible brass shield, and J the driving pin for the feeding mechanism.

The unison operates as follows: The free end of an arm, not shown in the diagram, rests in grooves between spiral threads cut on the escape-wheel shaft, see L, Fig. 2. This worm is provided with a unison stop pin M, Fig. 2, and upon continued rotation of the type-wheels, without printing, the free end of the arm resting in the grooves L, Fig. 2, will be carried to a position which will intercept a further onward movement of the stop pin upon the type-wheel shaft. This pin is so placed, that when it is locked by the unison arm the letter dot is opposite the paper, and pin A, Fig. 2, is opposite the left-hand arm of H, Fig. 2. This operation locks the type-wheels of all the instruments in unison. To release them and start them off together, the operator depresses the letter dot key, when the press-lever comes up and unison tripper F, Fig. 3, through the loop of which the unison arm passes, raises the latter from the unison pin M, Fig. 2, and a spiral spring pulls it to its original position in the groove between the two first threads of the unison worm, at the same time the type-wheels start to revolve.

The printing pad H, Fig. 3, is a small hollow cylinder of soft rubber, stretched over a cylinder of ebonite which revolves on a spindle, pivoted between the sides of the press-lever, as the paper is drawn over it. The paper feeding mechanism is very simple, and consists of two dogs or pawls, with sharpened serrated edges whose teeth point in the direction of motion of the paper. These pawls are always held down on the paper by spiral springs, and press the paper on a metallic barrel, which is free to revolve when motion is communicated to it. One of the dogs is slotted and pivoted on the pin J, Fig. 3, in the press-lever. An upward movement of the press-lever pushes this pawl forward, its sharp teeth catch the paper and drag it over the barrel. When the press-lever falls and the pawl starts on its backward path, the paper is clutched by the other pawl and thus the friction produced by the backward movement of the pushing pawl is prevented from dragging the paper backward. The transmitting apparatus for these machines will be described in our next.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

X, PART I—EARLY THEORIES OF ELECTRICITY.

ALTHOUGH, from the earliest period, the nature of electricity has been the object of much speculation, and since the time of Du Fay the probable occurrence of one or more kinds of electricity has been vigorously discussed, comparatively few of the persons who have interested themselves in the matter have ventured to advance even a hypothetical answer to the question,

"WHAT IS ELECTRICITY?"

Of the hypotheses suggested, the greater number originated during the earlier period of electrical history, and were founded upon a limited acquaintance with electrical phenomena; but, of them all, few are characterized by decided originality, fewer still are worthy of consideration as more than vague conjectures, and none, perhaps, are entirely accordant with the multitude of facts now known.

It may, however, be interesting, and in view of the influence they have exerted upon the progress of electrical science, perhaps important to review some of these suggestions, for they exercise the scientific use of the imagination, and represent the best efforts of the most able minds to grasp a problem the baffling complexity of which, modern scientific progress but enables us to realize, and contemplate, as the ancients did the phenomena of electricity, with wondering curiosity.

A problem thus impenetrable to modern science, Sir Francis Bacon, however, almost simultaneously with its first perception unhesitatingly disposed of as follows:[1] "Electricity (of which Gilbert[2] and others have devised such stories) is nothing else than the appetite of a body when excited by gentle friction, an appetite which does not well endure the air, but prefers some other tangible body if it be found near at hand."

Difficult as it would be to associate with others such an hypothesis, those which have appeared later may be roughly classified in order of dignity as follows:

- Early.
  - First, Supernatural.
    - Electricity a Soul or Spirit.
  - Second, Effluvial.
    - 1 Emanation and Return Theory.
    - 2 Spherical Envelope Theory.
  - Third, Fluid.
    - 1 Afflux and Efflux Theory.
    - 2 Agitated Envelope theory.
    - 3 One Fluid Theory.
    - 4 Two Fluid Theory.
  - Fourth, Ethereal.
    - 1 An universally extended imponderable fluid more or less condensed around a material substance.
    - 2 The same condensed about the Molecules of a body.
  - Fifth, Fire.
    - A universally extended imponderable fluid combining with Effluvia from the earth to form the atmosphere. The Ether, Electricity, and Fire one and the same.

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[1] Sir Francis Bacon. An Inquiry into Light and Luminosity. Works by Spedding. N. Y., 1856. Vol. 8, p. 3 8.

[2] See first sketch.

Modern.	Sixth, Mode of Motion.	1 All forces, modes of motion of Ethereal or Material Masses or Molecules. 2 The same. The Molecular motion considered as a Polar Oscillation. 3 All forces, modes of motion of material Masses or Molecules. The Ether and the Atmosphere one and the same.

Of these, the first five properly come under the head of early theories of electricity. Following no logical succession these have been, again and again, in various forms revived, and "how much ideas are bound up in words is shown by the use of the terms of one hypothesis in the expression of another."[3] In point of fact, terms belonging to each of them prevail more or less indiscriminately among modern electrical writers.

"Still the progressive stages in the history of general physical science account in great measure for the adoption, by the early electricians, of the supernatural, effluvial, ethereal, and fluid theories.

"The ancients, witnessing a natural phenomenon removed from ordinary analogies, and unexplained by any familiar mechanical principle, referred it to a spiritual or a supernatural power; and Thales expressed the

SUPERNATURAL HYPOTHESIS,

in attributing the phenomena of amber and the magnet, to a soul. Later, the functions of digestion, assimilation, etc., were supposed, by Paracelsus, to be effected by a spirit (the Archæus).

"The transition from the spiritual to the ethereal hypothesis occurred through the operations of the alchemists, who, seeking to convert ordinary metals into gold, subjected to intense heat various mixtures of substances in sealed vessels, which were almost invariably shattered to pieces by exploding. This frequent catastrophe was attributed to an antagonistic evil Geist (German) or spirit (English), to avert whose influence the divinity was appealed to by a cross usually marked upon the outside of the vessel. In course of time it was found that the Geist would escape harmlessly through even a minute opening left in the now so-called crucible (from Crux, a cross); and the word gas, a modification of the word Geist, applied to the escaping vapor after it became invested with a more material character, affords an instance 'of the gradual transmission of a spiritual into a physical conception,' which found expression in physics, in the tendency to attribute all mysterious natural phenomena to the escape, absorption, or chemical reactions of effluviæ, and introduced into electrical history the

EFFLUVIAL HYPOTHESIS,

one of whose earliest supporters, Robert Boyle, regarded electricity as an emanation of a subtile matter comparable with the emanations from volatile oils, flowers, and pungent acids or alkalies, as nitric acid or hartshorn, but especially characterized it as a glutinous emanation which seized little objects and carried them with it, upon its return, to the body from which it escaped.[4]

A certain Jacques Hartman, who published an article upon amber in the Phil. Trans.[5], pretended to prove by experiment, that the electrical attraction was produced by the emission of glutinous particles. He distilled a specimen of rosin, and found that the residue obtained was not electric, while the natural rosin, retaining its glutinous part, was a good electric.[6]

Hauksbee, in 1708, regarded electricity as an effluvium, which is developed from an object, such as a glass tube, or glass globe, when "affricated," and extends to a distance from the surface of the glass, both internally and externally forming, in case of a globe, a spherical envelope around it. Having some threads suspended in such an excited globe, which moved upon presenting the finger towards them from the outside, he inferred that the finger simply pushed the effluvium, and with it the threads, the interposed glass not interfering with the freedom of motion or continuity of its own effluvium.[7]

The hypothesis of an effluvial envelope, formed of an emanation from the excited electric, was favored by many of the early electricians, even to the time of Benjamin Franklin, who endeavored to effect a mixture of electric and odorous effluvia together, and was, therefore, not entirely disaffected toward this hypothesis.[8] But the effluvial conception gradually became still more materialized, "its further transition being assisted by Torricelli, who established the ponderable character of air and gases, and proving them analogous in many of their actions to liquids or known fluids, originated a tendency to regard them as aeriform fluids."

"No sooner was this conception established than a belief in the existence of other fluids, differing from air as air differs from water, insinuated itself in all branches of physics, and in explanation of every new phenomenon which presented itself a hypothetical fluid was immediately resorted to, and invested with such powers and properties as it might need to serve the desired purpose. Upon the idea of a fluid, thus was ingrafted a luxurious vegetation of imaginary offshoots."[9]

"The fluid caloric was long accepted as explaining the phenomena of heat. So was the luminous fluid at the same time as explaining the phenomena of light; but the falsity of all these conceptions is now considered quite certain, and though one of them satisfied the mind of Newton, it was condemned without hope of revival upon the day when Fresnel definitely formulated a more simple theory."

—— MR. G. A. ROWELL, assistant in the Natural History Department, at Oxford, England, has issued a circular, calling attention to the suggestion made by him forty years ago, which says: "My views on the cause of auroræ, are that they result from electricity carried over with vapor by the superior trade-winds, from tropical to polar regions, and its occasional accumulation in the latter to such a degree as to flash back to lower latitudes, through the atmosphere at a reduced density, but still within the regions at which vapor is flotable although in a frozen condition. The directive properties of the magnetic needle I attribute to the return current of electricity from polar to tropical regions. The following is the concluding paragraph of the report on my paper on this subject: 'the author supports his opinion by general reference to the observations on the aurora, &c., in the appendix to Capt. Franklin's "Journey to the Polar Seas," and concludes with proposing the experiments of raising electrical conductors to the height of the clouds in the *frigid regions during the frosts in winter*, which in his opinion would cause the aurora to be exhibited and lead to important discoveries in the science of magnetism' "—(*Report* of the British Association, 1840, *Transactions* of the Sections, p. 49.) In support of this theory, a foreign cotemporary refers to remarkable results recently obtained by Prof. Lemström, with a network of wires arranged up the face of the mountain at a station at Sodankyla, in North Finland. By this means he succeeded in procuring an appearance exactly similar to that of the aurora borealis.

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[3] Grove. Correlation of Physical Forces. N. Y., 1865. P. 95.

[4] Joseph Priestley. History of Elec. 3 vols., Paris, 1771. Vol. 1, p. 13.

[5] Abridgement. Vol. II, p. 473.

[6] Priestley. Loc. Cit.

[7] Hauksbee. Phil. Trans. London, 1703. P. 82.

[8] Franklin. Works by Jared Sparks. Boston, 1837. Letters, vol. V, p. 250.

[9] Grove. Loc. Cit.

TELEPHONING AND TELEGRAPHING.

THE problem of simultaneous transmission over the same wire, without interference of telephonic and telegraphic messages, it can easily be imagined, is a most difficult one; and, from a telegraphic standpoint, we would be inclined to say, an impossible one. But, nevertheless, from received statements, the problem seems to be solved, and the credit appears to be due to two Canadian gentlemen, Messrs. Black and Rosebrugh, the former a practical telegraph electrician, and the latter with an established reputation as an oculist in the city of Toronto.

These gentlemen have been associated in this invention since the spring of 1878, and in February, 1879, together, took out letters-patent in the United States, and subsequently in England, for the claims covering the essential features of their invention. A separate patent was also issued to Dr. Rosebrugh, at the same time, for certain features of the invention, the application for which was filed, we believe, as early as May, 1878.

On account of certain patents still pending, some features of the invention are withheld from the public for the present. We may say in general terms, however, that the telephonic apparatus is inserted in branch lines; grounding of the Morse circuit being prevented by the use of condensers of low capacity, and the keys bridged by condensers, for the purpose of keeping the induced current circuit unbroken. A phantom, or induced current circuit, is formed on the Morse wire for telephonic purposes; and a way wire may be used as a "through" telephone line, or a "through" Morse line may be tapped at intermediate stations with telephone branches, and used also as a "way" line for telephone business.

Again, the apparatus may be inserted in a bridge between two parallel wires, and the wires used as a metallic circuit, the "crossing" of the wires being prevented by the use of the condensers.

For completing the telephone circuit, either to ground or simply bridging a key, it is found that a condenser of low capacity, say ½ a micro-farad is quite sufficient. Recent practical tests in New York, Washington, and Canada seem to demonstrate the practicability of the invention. Its great value can hardly be overestimated, and its bearing upon future telegraphy can not, for the present, be more than conjectured.

AT a meeting of the N. Y. Electrical Society, held at the society's rooms, corner of Liberty and Greenwich Streets, this city, on March 9th, Mr. Charles S. H. Small, Asst. Supt. Gold & Stock Tel. Co., was elected President for the ensuing year. The meeting then adjourned till Friday, March 16th, when the following gentlemen were elected: 1st Vice-President, Geo. B. Scott; 2d Vice-President, Dr. P. H. Vanderweyde; 3d Vice-President, James D. Reid; 4th Vice-President Edward C. Cockey; 5th Vice-President, William J. Johnston; 6th Vice-President, Gerrit Smith; Recording Secretary, Thomas R. Taltavall; Financial Secretary, James McKenzie, Jr.; Treasurer, Francis W. Jones.

Additional members of the Executive Committee: Edward C. Cockey, E. L. Bradley, Henry L. Bailey, and Gerrit Smith.

Owing to the lateness of the hour at which the election of officers was terminated, the reading of papers by Mr. Cushing on the "Gray Harmonic Telegraph," and by Mr. G. A. Hamilton on "Cable Testing," were postponed until the next meeting. The Executive Committee have appointed Mr. Edward Blakeney, Librarian to the society.

OUR PARIS CORRESPONDENCE.

PARIS, March 10th, 1883.

EXPERIMENTS with M. Marcel Deprez's system of transmitting power to a distance by electricity, were lately made in the workshops here of the "Chemin de fer du Nord." We cannot speak of the results achieved from a full and personal knowledge, for, it is well-known, the data and calculations in such cases are only given to the public when they have previously passed through a beautifying process. As we have not been initiated into the secrets of the gentlemen who conducted the experiments, we must be content with what we could see in common with the other gentlemen invited. Well, our first impressions are by no means favorable. We have had a second edition in Paris, of the experiments made last October, between Munich and Miesbach; and the system of M. Marcel Deprez, does not seem to us to be one of those that improve with age. In Munich, a theoretical success was obtained, as the possibility of transmitting to a distance of 50 kilometres the force of a certain number of kilogrammetres by means of a simple telegraph wire, was amply demonstrated. No one had previously tried the experiment, which required a certain audacity—as it were. In Paris, with every possible facility at hand, we had a right to expect a conclusive and practical test, but we had to be satisfied with a mere blind trust in the experiments; to have volts and ampéres, measured on the terminals of the machines spoken about, and to have a lecture substituted for the dynamometer tests. Beyond this, there was nothing but mere gossip on a matter that is now well-known. There was little reason to disturb English electricians, and expose them to a most disagreeable trip across the Channel.

It will be of interest to trace the origin of this matter, and to show how it has developed since the Paris Electrical Exposition of 1881. At that time, M. Marcel Deprez was in the height of his glory; the Congress of Electricians furnished him with a splendid opportunity for having his merits appreciated, and every one seemed to recognize in him a first-class *savant*. He had discovered in electricity a field that had hitherto been but little explored, and one where his vivid imagination and theoretical knowledge could roam at will. He conceived the idea of a system for the distribution of power by electricity. It had seemingly—but only so—been utilized at the Palais d' Industrie, where sewing machines, lithographic presses and light machine tools were run by it. Visitors, having but an imperfect knowledge of electricity, were astonished at such liliputian contrivances.

A group of capitalists then determined to take advantages of these circumstances, and to facilitate the researches of M. Marcel Deprez, reserving to themselves any profit that might arise later from such initiative. They had—or they believed they had—the man for their purpose; the money was also forthcoming, and then the French Syndidate of Electricity entered on the campaign without any further reflection as to the final result of the enterprise. They were full of confidence.

There was every appearance of the matter proving a success in the early part of 1882. The Union Générale bank established the famous company for the utilization of natural forces, with a capital of 75 million francs. The company monopolized and absorbed every electrical system and improvement: Jablochkoff, Jamin, Werdermann, Reynier, Maxim, Weston, &c., while the distribution of electricity became its principal business, as well as that of M. Marcel Deprez. All these arrangements were upset, however, by the failure of the Union Générale, and the French

Syndicate of Electricity was compelled to look out for a better solution

M. Marcel Deprez did not busy himself with the financial questions and difficulties of this time, but remained, what he was before, a *savant*, continuing his investigations and multiplying his experiments. He finished his theoretical studies on the characteristics of the dynamo-electric machines, planned new models, made a new Pacinotti machine, modified that of Gramme and established, on paper, calculations for gigantic machines, &c. The Munich Electrical Exhibition seemed to furnish an opportunity for bringing those laboratory improvements before the public.

M. Deprez stated, in 1881, that in transmitting power by electricity, the result was independent of the distance—that is to say—the distance and the intermediate conductor being given, he could always build his machines so as to obtain a given result. The conclusion is indeed supported by theoretical deductions, but it is not confirmed in actual practice. An axiom that has been denied by engineers was to be proved, and it was thus proposed with all the confidence that is instilled by mathematical calculations, to transmit motive power from Miesbach to Munich, a distance of over 30 miles, by a simple telegraph wire of 4 or 5 millimetres.

The experiment may be qualified as a scientific success, but the results from an industrial point of view, were very poor. It was a vain effort to try and confound the electric product (the proportion of the product of the volts and ampéres of each electric machine) with the industrial product—or the proportion of the number of kilogrammetres furnished by the motor at Miesbach, with that of the kilogrammetres measured on the shaft of the receiver at Munich. The gentlemen interested in the matter would not be led astray, and the rather fanciful deductions that were made from the figures, were rather severely criticized. It must be admitted that the friends of M. Marcel Deprez contributed in a great measure by their undue zeal to bring these experiments into discredit. They gave at the very outset a return of 60 per cent., while the certificate delivered a few days ago by the Munich Electro-Technical Committee gives no more than 38.9 per cent ; and even then, only the electrical result is meant—that is, that the volts and ampéres were measured at the terminals of each machine, and the proportion of the volts and ampéres of the two machines was taken, and making allowance for all resistances, and only then, was this figure of 38.9 per cent. arrived at. It was even admitted that there were no losses on the 50 kilometres of the conductor; which, with the tension employed, cannot surely have been the case. The Electro-Technical Committee, in the only experiment that they cite, observed a return of 0.25 horse-power on the dynamometer in Munich; but they do not tell us how many horse-power were furnished by the motor at Meisbach. This fact, which was the only important one from an industrial standpoint, remains undecided, and thus the Munich experiments have really no practical value in our opinion They have, however, been useful, in so far as demonstrating the possibility of the electric transmission of power to a distance.

We believed that the new experiments, that were made by the "Chemin de fer du Nord," in Paris, would give us more complete data for forming an opinion, but we must say that such have been wanting up to the present. There has been even a lack of knowledge shown in the manner in which the machines have been put up. Instead of having the generator worked directly by a stationary engine, the power of which could be measured by the dynamometer and diagrams, the power was taken from a countershaft in the shops, so that the horse-power furnished could not be exactly ascertained. The generator and the receiver were, moreover, placed near one another, and connected, on the one hand, by a line-wire, of a variable length, of from 20 to 30 kilometres, and on the other, by an insulated cable of a few metres in length. The very conditions for practical tests were not fulfilled here, while they were in Munich. It is true that this is a very easy way to reduce the losses by the conductor

The non-scientific papers published long and enthusiastic articles—at so much a line—on these tests. A return of 50 per cent was spoken of; and it was stated that of 10 horse-power received by the generator, 5 were returned by the receiver. We cannot conceive how such conclusions as these could be arrived at from the foregoing data, unless by measuring volts and ampéres on the terminals of the machines, which is a very simple but misleading proceeding

Whenever electric transmission has to be made, it must be borne in mind that manufacturers, and not professors of natural philosophy, have to be satisfied. The return that we have to obtain, or determine, is not, therefore, the standard proportion of the products, *E T*, but the proportion of work furnished at one extremity, to the work received at the other. The manufacturer cares but little about the intermediate agent; it may be electricity, gas, compressed air, water, or steam; he only looks for kilogrammetres; he does not want to know how they come, but how much they cost, and the dynamometer can alone give him the necessary information in this respect. To adopt any other method of operating may, indeed, be a work that proves a *savant*, but not an engineer; and the mistakes and errors that have been already caused by the Munich experiment, ought to have shown M. Marcel Deprez, that in following up the same wrong path he would only expose himself to another failure.

PH. DELAHAYE.

SPEAKING TELEGRAPHS.

SOMERVILLE, MASS., March 6, 1883.

To the Editor of the Electrician.

I have copied the subjoined item from *Gleason's Pictorial* (Boston), issue of April 17, 1852.

It is, at least, an early suggestion of a speaking telegraph.

Yours, truly, FRED. W. STONE.

THE French and English journals are speculating on the practicability of turning the electric telegraph, that connects England and France, via the channel, into a medium of conversational intercourse. The *modus operandi* is this : A plate of silver and one of zinc are taken into the mouth, one above, and the other below the tongue. They are then placed in contact with the wire, and words, issuing from the mouth so prepared, are conveyed across the Channel by the way—in a whisper, we suppose, though the account does not say. It has been tried, it is said, with successful results.

—— THE LONDON *Electrical Review* says : The Force and Light Company, controlling the storage battery patents of the French inventor, Faure, are at present engaged in legal warfare with an English company claiming to have rights in the Faure patents, and with the Brush Company, which has lately put a storage battery, said to have been invented by Mr. Brush, into the market. The Brush Electric Light Company have made common cause with the Swan Electric Light Company of England against the Edison Company, which latter organization is suing the Brush Company for using a lamp (Swan) somewhat like Edison's, while the Force and Light Company is suing, because Brush wants to light his Swan lamps from a battery which resembles Faure's.

TABLE OF C. G. S. AND ENGLISH UNITS.

BY BRADLEY A. FISKE, U. S. N.

1 Gramme = 15.432 grains.
1 Gramme = 981 dynes.
1 Lb. = 445,900 dynes (approximate).
1 Dyne = .00000224 + lbs. (approximate).
1 Grain = .0648 grammes.
1 Metre = 39.37 inches.
1 Kilometre = 1093.6 yds.
1 Erg = 1 dyne-centimetre.
1 Foot pound = 13,586,850 ergs of work = 13 + meg. ergs.
1 Foot pound = .1385 kilogrammetres.
1 Kilogrammetre = 98.1 meg. ergs.
1 " = 7.220 foot pounds.
1 Volt = 10^8 c. g. s. units.
1 Ohm = 10^9 " "
1 Ampére = 10^{-1} c. g. s. units.
1 Coulomb = 10^{-1} " "
1 Farad = 10^{-9} " "
1 Calorie = 42 x 10^6 ergs = 1 gramme water 1° C.
1 Eng. heat unit = 772 foot pounds = 1 lb water 1° F.
1 Horse-power = 550 foot pounds per second.
1 " " = 33,000 foot pounds per minute.
1 " " = 1,980,000 foot pounds per hour.
1 " " = 76. kilogrammetres per second, English measure.
1 Horse-power = 75 kilogrammetres per second, French measure.
1 Horse-power = 7,460 meg. ergs per second, English measure.
1 Horse-power = 7,357.5 meg. ergs per second, French measure.
Unit of electrical *work* = volt-coulomb or vomb (suggested).
1 Vomb = .737 foot pounds.
1 Meg. vomb = 737,000 foot pounds.
Unit electrical *energy* = volt—ampére or watt.
1 Watt = 10 meg. ergs per second = $\frac{1}{9.81}$ kilogrammetres per second = $\frac{1}{746}$ horse-power.

59, Astor House, New York.

THE AURORA AS AN ELECTRICAL MANIFESTATION.

CHICAGO, March 15, 1883.

To the Editor of the Electrician.

DEAR SIR:—The sixty-fourth regular meeting of the Chicago Electrical Society was held February 19, in the lecture hall of the College of Pharmacy. The subject for the evening was, "The Aurora as an Electrical Manifestation." The paper bore evidence that the lecturer, Mr. C. C. Haskins, had carefully studied his subject, and acquainted himself fully with the most popular and widely accepted theories concerning the nature and causes of these natural displays, basing his paper largely on M. Angot's recent writings on this subject, from which source he also procured the illustrations.

The spectroscope has shown that the theory of reflection, which has, until recent times, obtained very general acceptation, is untenable, the spectrum lines of the aurora, differing from those of the sun-light in several important particulars. The theory that it is caused by the passage of currents of electricity between the earth and the upper atmosphere, explains more nearly than any other, all of the known facts and manifestations. The lecture was fully illustrated.

The *Chicago Tribune*, in giving an abstract of the lecture, says: "Mr. Haskins divided auroral lights into two grand classes—those having comparatively little movement, and those of a more restless or active character. The various forms of polar light include faint, indefinite illuminations, those resembling cirrus or cirro-stratus clouds, arches of light reaching from horizon to horizon, arches with radiations, rays of light which converge to some point in the heavens, and lastly, light bands not homogeneous, composed of many rays closely crowded together. These various forms mingle in different proportions, a display often exhibiting two or more of these species.

Of the first or indefinite illuminations, there are varieties; sometimes a bright crimson light covers the entire heavens; again, the light may be like that of tardy northern twilight, and occasionally of a phosphorescent character. The cloud-like auroras are vague, indefinite in form, sometimes dense, often resembling tufts of cotton-wool, and numerous instances are recorded where doubt has been raised as to their actual character. Cirrus clouds often show colors through the medium of ice-crystals in the air. Similar results may be had by viewing the sun or moon through frosted window panes.

Sheets or bands of light exhibit at times a restlessness of great beauty—dilating and contracting like sea-polyps in swimming. A mass of light of this description, of a roseate hue, was seen about seven feet above the surface of Lake Wetter in July, 1877, which crossed to the wooded shore, about 2,400 feet, in about two seconds, the phenomenon being twice repeated. The records of Ross' expedition mention a light of similar character, which the vessel sailed through without harm.

Mr. Haskins described the various forms mentioned, citing cases and fully illustrating them by means of slides and the oxy-hydrogen lantern. A series of these plates, taken at short intervals, showed the evanescent character of some of these displays during one night. He cited cases where one form of aurora was duplicated as many as nine times, on one occasion, in different parts of the heavens, as recorded by the officers of the Search.

One form was illustrated by a picture representing a huge semi-circular cloud, pierced by rays or fires, like streams of water from a rose-nozzle. The ancients deemed this arch the cavern from whence the gods launched the fires of heaven.

THE DRAPERY FORMS,

the most beautiful of all the auroras, closely resemble delicate frills and lace work, like curtains, suspended, gracefully folded back upon themselves, were shown upon the screen in great variety. The hues of auroras are varied, extremely delicate, and pure. White, shaded into yellow, is by no means uncommon. Next in order ranks carmine-red, while green, violet, and blue are less common, but often seen. The spectroscope resolves the auroral light into bands or lines which are bright red, bright yellowish-green, a second faint green, a very brilliant green, bright greenish-blue, a still brighter pure blue, and a violet, lighter in the centre, deepening toward the edges. By the instantaneous process, the aurora may be photographed.

The extent of auroral fields is extremely variable. Cases were mentioned where expeditions in the same general locality failed to witness the same display—notably the Alert and Discovery wintering in Smith's Straits, only sixty miles apart. During the entire period of their sojourn, only seven simultaneous instances were recorded, while the aurora of Aug. 28 and 29, 1850, was seen at the same hour all through Europe, in Western Africa, in the Atlantic, Cuba, and North America. On another occasion, a Northern aurora—February, 1872—was witnessed throughout Europe, North Africa, and the Atlantic, while a Southern display was visible in Australia, Mauritius, Reunion, and Natal. The two displays were separated by a zone of only twenty degrees either side the equator.

A circum-polar map on the screen showed lines of comparative frequency, increasing with increasing latitude, until a line of no aurora is reached. North of this, all displays are seen in a Southerly direction. The centre of this curve is found to be nearer the magnetic than the geographic pole. On this fact hinges

THE THEORY OF THEIR CAUSE.

Particular forms of these lights are more prevalent in certain localities. North of Behring's Straits the displays are nearly all of the homogeneous arc type, while the drapery form affects those regions like Northern Norway, Novazembla, Franz Joseph's-Land, and the East of Greenland, where the seas remain unfrozen.

Terrestrial currents are often, but not always, present during these displays. The current storm of November 17th and 18th last year, which interfered with all the telegraph lines in this country, from Nashville North interfered with all European lines, from the British Islands to Norway, and auroral lights were visible there, except where daylight extinguished them. During that storm, hundreds of miles of telegraph lines were worked, either practically or experimentally, from nature's own reservoir batteries, and an Edison lamp, burned at Milwaukee, from an earth current, at about one-eighth its illuminating power.

Abundant testimony seems to point to the conclusion, that the magnetic force of the earth has a decided bearing upon the direction of these lights. Meteorological conditions possibly—nay, probably—do, to some extent, influence them, but, so far, this connection alone is well authenticated: Clouds may replace auroras at the approach of day, and these in turn give way to auroras of the same shape at nightfall.

THE MANY THEORIES OF AURORAS

are grouped into four classes: Cosmical, optical, magnetic, and electrical. The cosmical, which attributes their production to causes exterior to our earth, before being accepted must answer, Why do they not then have an apparent orbital movement, like other heavenly bodies?

The second, which assumes them to be mere light reflections, is disposed of by the spectroscope, which fails to find the requisite evidence in their spectrum.

The magnetic theories fare little better. The assumption that showers of ferruginous powders form the media of equalization between the surcharged upper air and the earth, is met in objection by the fact, that in localities where such showers are quite frequent, few auroras are seen; and again, that at the magnetic North Pole, where the power of attraction is most potent, there are none at all.

The electrical theories seem better to answer the requirements of the problem. The well-known Geissler tube, which shows the electric spark as a continuous, feeble, milky, or colored light, in its passage through various rarified gases, is the best aurora in miniature which has yet been conceived. Varying the gases will vary the colors."

The lecture was fully illustrated by a large number of lantern projections, exhibiting the most noted and striking forms of the Aurora which have been recorded by observers in all parts of the world. At the close of the paper the lecturer made several experiments with the Holtz machine; and by means of a Geissler tube, three feet long and two inches in diameter, containing rarified nitrogen gas, he showed a beautiful brush aurora, and some of the other forms.

He also showed a beautiful experiment, new to nearly all of the audience, exhibiting the glass tube previously referred to as a Leyden jar. After charging it from the Holtz machine, he discharged it by passing his hand over the tube, obtaining a fine brush light wherever the hand approached the tube. He also excited the charged tube to luminosity, by breathing on it, obtaining a fine light, through the induction thus set up. This experiment shows why we do not have auroras at all times—movement of the current is necessary to develop the luminous properties.

At the close of these experiments, Prof. N. Gray Bartlett exhibited on the screen, the spark of the Holtz machine, by means of magnifying lenses. When the spark was short, its course was perfectly straight; but as the distance between the points was increased, the track of the spark became very irregular.

The audience, which was very large, seemed to feel that they had been amply repaid for their time and attention.

THE SCRIBE.

—— **THE TELEPHONE** has achieved a wide degree of usefulness in Cincinnati. One hundred and thirty villages, within a radius of 75 miles, are within speaking distance of the city.

CAUSES OF DANGEROUS CHARACTER OF INTERMITTENT CURRENTS.

IN a lecture recently delivered at the London Institute, Professor Ayrton explained, in a very clear and striking manner, the reasons why an intermittent current is so much more dangerous than a continuous one of the same electro-motive force. We take the following extract from an account of the lecture published in the London *Electrical Review*:

"The danger arising from the use of high potential can be very much diminished if, instead of using the earth as part of our return circuit, we employ not only an insulated wire to convey the current, but also another insulated wire to bring it back again, and if, in addition, the current flowing through the whole circuit is not intermittent. This may be shown by the following experiment: Attached to these wires, well insulated from the ground, are the insulated coatings of this battery of charged Leyden jars. Now, although the difference of potentials between the wires is some thousands of volts far, far greater than is at present used, or proposed to be used, in any system of electric transmission of power, I can, as you see, touch either wire with perfect impunity. But if either of these wires be replaced by a wire in contact with the earth, say replaced by one of the gas pipes, and I were now to touch the other, I should receive a violent shock.

"As, however, my love of electric experiments does not extend to shocks, I will touch the insulated wire by deputy, using this metallic rod, and the result is, you see, a bright spark. [Experiment shown.] Both the going and return wires, therefore, should be insulated.

"But next, the current flowing in them must not be discontinuous, if danger is to be avoided. For, if, instead of keeping the difference of potentials between any two points in the two insulated wires constant, I allow rapid fluctuations in this difference to take place, then, no matter how well the wires be insulated, a violent succession of shocks will be received on touching either of the wires, even although the other be not touched, so that no circuit in the ordinary sense is completed through the body. To show this experimentally, I shall replace this insulated battery of Leyden jars with an induction coil, which, as well as the voltaic cells used in charging it, are thoroughly well insulated from the earth in every part. Let me, however, touch either of these wires—again by deputy—and you see bright sparks passing to the earth. [Experiment shown.] Bear in mind that I am touching one wire only, not both, so that although the Ruhmkoff coil is doubtless an old friend to you, I am using it to-night in a new way to illustrate my point.

"Now let us consider why it is that when a current goes and returns by a wire completely insulated from the ground, no shock is experienced when the current is perfectly steady, even if a bare part of the wire be touched; but if there are rapid variations in the current strength, severe shocks are felt, even if only one part of the wire be touched.

"In each case the effect of touching the wire is to reduce the potential of the point touched to that of the earth, and to effect a corresponding alteration of the potential along the whole line. This means the addition to, or a subtraction of, a certain quantity of electricity from the wire. In the case of a perfectly steady current, this operation only occurs *once* for once touching the bare wire, and unless the electro-static capacity of the wire be very great, or the potential of the point touched immensely different from that of the earth, this *single* addition or subtraction of electricity produces hardly any perceptible feeling. But in the case of a varying current, the potential of the point would naturally be undergoing constant variations of potential, so that in order to keep the point touched at the same potential as that of the earth, constant additions and subtractions of electricity are necessary, and if these occur with sufficient rapidity, a severe shock is produced, even although the body forms no part of the main circuit.

"A single puff of air through this syren produces no audible sound; a rapid succession of even minute puffs, a loud roar; so the single small electric discharge is not perceptible, but the rapid shower of liliputian arrows is terribly painful. This, indeed, is the same analogy Professor Perry employed in his lecture at the Society of Arts to prove the powerful action of rapidly recurrent effects in connection with our method of signaling to ships by means of sound waves, sent through the water itself.

"High potential, I have explained, is absolutely necessary for economy in electric transmission of power, and I hope I have also made it clear to you, that contrary to the received opinion, this high potential is not, necessarily, at all dangerous to life, if the currents employed are not at all discontinuous But the discontinuity of current we have to deal with is not merely the discontinuity that exists in the so-called reverse current machines. Even many dynamos, like the Brush, do not produce a really constant current, although generating a current of sufficient mean constancy to cause a perfectly steady deflection on one of the ordinary ammeters of Professor Perry and myself, an instrument, be it remembered, so dead-beat that it records with perfect accuracy the change of current produced every time the joint in the driving belt passes around the pulley of the dynamo, as well as the regular increase of current at each of the explosions of the gas in the cylinder of a gas engine.

"The variations of current, I am now referring to, occur many hundreds of times a minute, and although they cannot be detected by ordinary current meters, and although but little attention has been given to them, they are, in my opinion, a source of great danger when the dynamo produces a high electro-motive force.

"In any machine for the mechanical production of electricity a coil must, as you no doubt all know, be alternately rapidly brought up to a magnet and then withdrawn. Bringing up the coil produces a current in one direction in the coil, and withdrawing it, a current in the opposite; and, although by a simple piece of mechanism, called a commutator, the direction of the current in the external, or useful portion of the circuit may be always kept the same, even although the direction of the current is alternately reversed in the coil, no mechanism can make the coil produce a current at the moments of rest, when it changes its direction of motion. Wheatstone, in 1841, proposed to overcome this difficulty by combining two or more dynamos in series, like the two cylinders of a steam engine, in such a way that the current produced by the one was strongest when the current produced by the other was weakest; but Pacinotti, in 1860, showed us scientifically, and Gramme, in 1870, practically, how to combine a number of moving coils in one machine, so as to give a current comparable in steadiness with that produced by a voltaic battery The power of any dynamo depends roughly on the speed at which the coils move, and on the strength of the magnetic field in which they move. Now, from the construction of the well-known Gramme machine, the strength of this magnetic field is necessarily weak when the machine is made of large size, so that the greater power and efficiency which ought to come from enlarging the machine, is partially compensated for by the relatively weaker magnetic field; indeed, even in a small Gramme machine, the magnetic field is probably weaker than the magnetic field produced long ago in the old reverse current machines of Holmes and Wilde Hence, more recent inventors, like Brush, have adopted a compromise between the perfect uniformity of strength of current obtained with the Gramme dynamo, and the strong magnetic field in the old reverse current machines. But, in almost all the high electro-motive force dynamos, continuity of current has been somewhat sacrificed to strength of magnetic field. The plan, however, described in 1870 by Prof. Perry and myself, of oblique coiling of the armature, has enabled us, especially in our recently constructed machines, to combine the continuity of current, produced by a Gramme, with the powerful magnetic field necessary for obtaining high electro-motive force, and these results are in no way diminished when the machine is increased to the size necessary for utilizing hundreds or thousands of horse-power, and for obtaining that high efficiency which, both theory and practice show, is obtainable with the use of very large dynamos.

"The next point to consider is, how can we measure the amount of this dangerous discontinuity in the current produced by a dynamo, without having to resort to the inconvenient process of killing off a certain number of people. We want a 'discontinuity meter,' and such an instrument I have here, employed by Prof Perry and myself for this purpose. It consists simply of an induction coil in which both the primary and secondary circuits are of thick wire. The one is put in the main path of the current, the other is attached to one of our 'spring ammeters,' which measures the mean square of the strength of the reverse currents produced in the outer secondary coil by the intermittencies of the main current.

"Now, what are the results obtained when such an instrument is practically employed? Why, we find that when a current of ten ampéres produced by a three-light Brush dynamo is flowing through the primary, there is a reverse current through the secondary which increases to about five ampéres, when the secondary is nearly short circuited, and which, be it remembered, is produced merely by the commonly ignored discontinuities in the current in the main current produced by the Brush machine. On the other hand, when the same current, ten ampéres, is sent through the primary by a Gramme machine, running at about the same speed, no visible current, certainly not a quarter of an ampére, is produced in the secondary. Hence, it is clear that the continuity of the Gramme current is immensely greater than the continuity of the Brush current.

"A telephone may also be used as a discontinuity meter, the two terminals of which are, in different experiments, attached to two points close together in the main circuit of the dynamo. For quantitative experiments these two adjacent points in the main circuit should be selected, so that in all cases there is the same difference of potentials between them, and then the pitch of the note heard in the telephone will tell the number of variations per minute in the main current, and the loudness of the note the magnitude of such variation.

"And I strongly advise any one who is procuring a high electromotive force dynamo, to ascertain for himself before purchasing, the magnitude of the discontinuity factor of the machine, and about which he will find no information, as a rule, given in any description of the machine"

THE VIENNA ELECTRIC EXHIBITION.

THE Vienna correspondent of the London *Standard* refers to the exhibition at Vienna, as follows:

"The Crown Prince, (Rudolph), who is now on a visit to Berlin, will communicate with the German committee, which, with the help of the Electro-Technical Society, and men like Dr. Werner Siemens, is expected to bring together a great collection of the most important recent appliances. The Americans will also probably take a prominent part in the exhibition, but, owing to the great distance, they are among the latest to send in their announcements. Although England, Germany, and America are all late in their applications, the Vienna committee have sufficient promises to make it pretty certain that those countries, in common with the nearer Continental States, will be well represented. Such an opportunity, in fact, as the Vienna exhibition will offer for the extension of the electric light and other applications of electricity in the East of Europe, in Russia, Roumania, Servia, Greece and Turkey, as well as in Austria and Hungary, is not likely to present itself again for a long time to come The exhibition will be held in the Prater, the great park of Vienna, and the favorite resort of the vast population of the city throughout the summer. The building in which the display will be collected is the rotunda, the largest covered hall upon the European continent. The space over which this edifice extends is more than a quarter of a million square feet, being more than double the area available at the late exhibition at Munich. Among the principal features of the exhibition I may mention, in the first place, the exhibits of M. Marcel Deprez, whose developments of electric art in the way of transmission of electric power are among the most important of recent times. At Munich, M. Deprez was able to use in the exhibition the water power furnished by a small cascade thirty-five miles distant, the medium of transmission being nothing more than an ordinary telegraph wire. The loss of power, then, however, was slightly over sixty per cent. By the help of improved machinery, he has already reduced this loss very considerably, and he expects to show still better results at the Vienna exhibition, where his experiments will be shown on a grand scale, and where he promises to prove to demonstration the entire correctness of his views on the transmission of electric force. There will likewise be rivals in the same section in the persons of M. Gravier, of Warsaw; M. Ganz, of Pesth; and M. Krizik, who is already known as the inventor of the Pilsen lamp. M. Gaston Plante, inventor of the accumulator, and M.

Gautheret will also be among the exhibitors in this new field. Another department, in which much that is novel and surprising will be shown, will be that having to do with scientific measurements connected with electricity. Since the Munich exhibition there has been remarkable progress made in this section, which will be fully illustrated in Vienna. The measurement of the degree of light in the various electric systems will here be illustrated. There will also be a few new systems of electric lighting shown, both of the arc and incandescent descriptions. Messrs. Krizic and Scoda, of Pilsen, will show a single arc light equal to twenty thousand candles in effect, and produced by a sixty horse-power engine The Société Anonyme, of Paris; Edison's Company, of New York; and Deckert and Thomalto, of Vienna, will also compete with various novelties in this department Another interesting portion of the exhibition will refer to new applications of electricity for various scientific purposes, including electric optical instruments, medical appliances, apparatus for the examination of the interior organs of the body, and electrolithic batteries. There will also be new electric railway signals, electric rail shifters, point indicators, electric type printing with single wire, and a new phonophone for musical transmission. There will be an electric railway running through the principal avenue of the Prater to the exhibition. Some of the Vienna theatres are also to be connected with the rotunda by telephone, so that the performances may be heard in the exhibition. The Baden theatre, ten miles distant, will be similarly connected. From this somewhat brief sketch, it will be seen that the Vienna Electrical Exhibition of 1883, promises to be full of interest, not to the electricians and specialists only, but to the traveling public generally."

Applications for the receipt of space, were extended from the 1st to the 20th of March.

EXPERIMENTS WITH ELECTRIC LIGHT ON PLANTS.

THE *Journal of the London Chemical Society*, for January, gives an abstract of a paper by M. P. P. Déhérain, of experiments made in a conservatory during the electric exhibition at Paris, in August, 1881 : A greenhouse was constructed and divided into two compartments, one of which was glazed with blackened perfectly opaque glass, whilst the other was exposed to the ordinary diffused daylight of the exhibition building. The darkened chamber was illuminated continuously, night and day, by a 2,000 candle arc light from a Gramme machine, driven by an Otto gas engine. The transparent chamber was illuminated at night only by the electric light. Five series of observations were made, viz.: 1. Plants exposed night and day to the electric light alone. 2. Plants exposed during the day to the diffuse daylight of the Palais, and during the night to the electric light. 3. Plants living during the day in the open air, and receiving the electric illumination at night. 4. Plants passing the day in the diffuse daylight of the Palais, and the night in darkness 5. Plants living normally in a garden. The plants submitted to experiment were barley, flax, beans, and a number of garden and greenhouse plants. At the end of seven days, the naked electric light was seen to have an injurious effect both on those plants which were constantly subjected to it, and in a less degree on those which were exposed to it during the night only. The leaves blackened, withered, and dropped off; the injury was confined to the epidermal layers, and was due to the direct impact of the luminous radiations (and not to the formation of nitrogen oxides); for, where one leaf was partly shaded by another, a sharp line was photographically impressed. Experiments on *elodea canadensis*, submerged in flasks of water, showed that whilst the diffuse daylight of the building was unable to cause decomposition of carbonic anhydride and evolution of oxygen, the direct rays of the electric light were able to do so; about as much oxygen being obtained during an exposure of four or five days and nights to the electric light as could be obtained in an hour or so in bright sunlight. At the end of fifteen days the arc lights were enclosed in globes of transparent glass, Siemens's just published experiments having shown that the injurious action of the direct radiations was thereby modified. A number of fresh and uninjured plants were placed in the greenhouse, and, in addition, sowings of barley, oats, peas, maize, beans, which had just appeared above the ground. All the seedlings exposed exclusively to the electric light, perished sooner or later, and the leaves of some of them were blackened as with the naked light. The mature plants, on the other hand, continued to vegetate, but in no case, save a plant of barley, were flowers and seeds produced, the vegetation being purely foliaceous. The barley grains were normal, and germinated on being sown. The electric light employed was clearly insufficient by itself to determine the assimilation of any considerable quantity of material. Direct experiments also proved that it is not more powerful in exciting transpiration of water, a leaf exposed to it giving off in an hour only about one-fiftieth of the quantity of water evaporated under similar circumstances in sunlight. As the evaporation of water by the leaves is one of the chief agencies in causing the migration of material necessary for the maturation of seed, the failure of the plants to produce flowers and seeds receives its explanation. It is known that yellow and red rays are most powerful in causing transpiration, whilst the electric light is particularly rich in blue and violet rays. The author considers the electric light employed as too feeble to allow of any conclusion as to the necessity of a nocturnal rest to plants. It was, however, evident that the electric illumination during the night was advantageous to those plants which passed the day in the rather feeble diffused daylight of the Palais. In a third series of experiments, the intensity of the electric light was practically augmented by placing the plants nearer the lamp. The experiment was again fatal to young seedlings receiving the electric light exclusively, but many of the hardier and more mature plants survived, although the leaves of some were blackened by their too great proximity to the light ; and again the nocturnal electric illumination was decidedly favorable to the plants which passed the day in the light of the Palais. The author sums up his conclusions thus : 1. The electric-arc light emits radiations which are injurious to vegetation. 2. Most of these radiations are arrested by colorless glass. 3 The electric light emits radiations powerful enough to maintain mature plants in vegetation for two months and a half. 4. The beneficial radiations are not sufficiently powerful to cause the growth of germinating seeds, or to allow of the maturation of fruit in older plants.

ON THE CHARACTERISTICS OF INDUCTED CURRENTS; RESULTING FROM THE RECIPROCAL MOVEMENTS OF TWO MAGNETIC BODIES PARALLEL TO THEIR AXIS.

IF one of the poles of a permanent magnet be passed lengthways before a straight electro-magnet, that has its spiral connected with a galvanometer, we shall have three inducted currents successively developed. The first of these currents is caused by the approach of the inducting pole, and corresponds to an *inverse, or magnetizing,* current ; a second current results from the movement accomplished by the inductor, from one end to the other of the electro-magnet, and which is in a contrary direction to the first, while a third is shown at the moment of separation from the inducting pole ; and which, although in the same direction as the first, is *direct*—or corresponding to a demagnetizing effect. This latter is in the same direction as the first, because the action, being effected in both instances on the dissimilar ends of the electro-magnet, the effects which should be inverse, are rectified thereby. If a movement be now imparted to the inducting pole, that will comprise the totality of the three movements which we have analyzed, the galvanometer will indicate *but a single current, the direction of which will correspond with that produced by the inducting pole, proceeding from one end to the other of the core,* and it is the strongest, because it arises from the reaction that has taken place nearer to the magnetic core of the electro-magnet, and is developed with the same intensity during the entire course of the inducting pole. This current belongs to the class of currents that I have designated by the appellation of *polar inverted* currents.

If the iron core of the straight electro-magnet be polarized, by placing it in contact with one of the poles of an electro-magnet, or powerful magnet, and the above-mentioned experiments be repeated, we shall perceive that *this polarization does not exert any influence on the direction of the inducted currents that are developed;* their intensity alone varies, being less when the poles that are opposed to one another, in the movement of the inductor, are of the same name, and greater when these poles have contrary names. *Only the nature of the inducting pole, or the direction of the roll of the spiral of the electro-magnet, exercise any action on the direction of the currents,* and it can be easily proved that these effects are due to the polarity action of the inductor, for if a piece of soft iron is substituted for the inducting magnet, it will be seen that the currents arising from the preceding experiments *vary in direction according to the polarities of the core of the electro magnet.*

It results from this, that the polarization of an iron core renders a certain quantity of magnetism immovable, and which is, consequently, unaffected by the dynamic excitement that is produced by exterior magnetic reactions, and which is only influenced when acting on the inductor itself, which over excites its energy, it can polarize it in turn, so that the action and reaction are effected in a concordant way. It is very singular that a *very weak magnet may produce the actions which we first explained,* and which, as we have seen, are very different from those produced by soft iron.

One consequence may be deducted from this kind of effects, viz.: that the inducted currents, that are due to the approach of the inductor to the polarized core, are in the same direction as the current which produced the magnetizing of the latter, when the opposite poles are of the same name at the moment of approach, which is the inverse of the ordinary cases of magneto-electric induction. This fact may explain, perhaps, how the motor in Griscom's electro-motor profits by all the inducted currents that are developed in it.

I wished to ascertain whether the foregoing effects were the same for a *closed* electro-magnetic system and an *open* electro-magnetic one I, for this purpose, polarized the straight electro-magnet, sometimes by a single pole, and again by both poles at once In the latter case, I placed the straight electro-magnet between the poles of a horse-shoe electro-magnet, arranged for the purpose. The system was then *closed*, and when one of the extremities of the electro-magnet touched one of the poles of the same magnet in horse-shoe shape, the system was *open*. By repeating the above experiments, I found that the effects, with regard to the direction of the inducted currents produced, were always the same, but that the relative intensity of the currents were very different.

Thus, the currents due to the approach of the inductor, which, with poles of contrary names present and the magnetic system open, are more energetic than when these poles are of the same name, become, on the other hand, less energetic with the magnetic system closed. A similar effect is produced when the non-polarized system is acted on. The currents produced by approach are then almost double the intensity with the open than with the closed system, which is easily understood, when it is considered that in the open system, magnetizing by influence is only effected on the core that is covered by the spiral, while with the closed system, it is divided between the two cores.

When, instead of reacting on the complete electro-magnetic system—that is, on the system provided with the iron core—we operate the inducting pole on the spiral only of the straight electro-magnet, we have the effects again that we first analyzed, but the inducted currents that are produced, give only galvanometric deviations, that are scarcely perceptible from 2° to 3°, and the current resulting from the three combined movements is almost null. This proves that the action of the magnet on the wire is infinitely less than it is on the magnetic system that occupies the centre of the spiral

TH. DU MONCEL, in *L'Electricien.*

—— THE *Herald*, March 27th, says: The Postal Telegraph Company yesterday opened its line for private test between New York and Chicago and everything worked perfectly. The resistance of the wire showed only 1,522 ohms, as against 6,000 ohms on the best iron wire and [illegible] ohms on the average iron wire. Professor Elisha Gray and H. [illegible], Vice-President and General Manager of the Postal Telegraph Company, conversed freely and distinctly with Mr. Taylor, the company's [illegible] at Chicago, a distance of 1,000 miles.

SPARKS.

—— IN ONE WEEK, recently, the number of messages sent through the telephones at the London exchange reached the enormous number of 40,000 daily.

—— MORSE, who invented the telegraph, and Bell, the inventor of the telephone, both had deaf-mute wives. Little comment is necessary; but just see what a man can do when everything is quiet.

—— THE LIGHTHOUSE BOARD has leased the property at Hallett's Point, Hell Gate, New York harbor, selected as a site for the new electric light tower, the erection of which will soon be commenced.

—— THE CONNECTICUT LEGISLATURE is considering a bill compelling telegraph companies to keep their offices, in towns of 6,000 inhabitants, open all night, and to furnish messengers at all times.

—— THE *Journal Télégraphique du Bureau Central de Berne*, summarizing the principal lacunæ in the universal system of telegraphy, notes as one, the construction of a line to Iceland, for recording the principal atmospherical events observed in the polar regions.

—— THE *Providence Journal* congratulates its city on doing, for its size, more "halloing" than any city in the world. There is a telephone subscriber to every 72 persons, while it is one to every 253 in Boston, to every 400 in New York, to every 471 in Paris, and to every 2,563 in London.

—— IN THE REPORT of the Mass. Railroad Commissioners, issued last week, much attention is devoted to the use of electric signals on the roads which are provided with them, and their general use is strongly recommended. This is as strong as they can state the demand, as the powers of the board are only advisory.

—— WHEN IRON IS MAGNETIZED the re-arrangement of the molecules, due to magnetization, produces a slight noise. In some experiments, with an alternating current dynamo, the continuous reversals of magnetic polarity in the iron core of an electro-magnet, produced a crackling noise, similar to the bending of a bar of block tin.

—— IN ARRANGING electric lighting circuits for interior use, especially mills and industrial establishments, care should be taken to arrange the lamps in the darker portions of the buildings, and those lamps in the better lighted places, on different circuits; so, that on dark days, and mornings and afternoons, one dynamo can be used at its best advantage.

—— HERE IS A HINT for telephone operators. A paper has been circulated in Keene, N. H., with the following heading: "We, the undersigned, in consideration of the kind and patient cheerfulness of Miss ——, shown at all times to all by the tone of her voice, do cheerfully pay the sums," etc It was crowded with signatures, representing a handsome sum of money in the aggregate.

—— THE FRENCH GAS COMPANIES have instituted at their common expense, a laboratory for testing the several inventions reported in electric lighting, and proving whether they are valuable or not. After alluding to this foundation, and the much spoken of experiments tried at the French Great Northern Railway Station, a French scientific periodical says: "Better to have a wise enemy than an imprudent friend."

—— CAPT. F. V GREENE, United States Engineer Corps, has been instructed by the commissioners to visit New York, Philadelphia and Boston, and examine the devices used in those cities for underground electric light, telephone, and telegraph wires, with a view to decide upon the proper course to be pursued by the local authorities.

—— A COMMEMORATIVE STONE has been placed on the house, No. 17, in Via Dei Prefetti, Rome, to Morse, the telegraphist. The inscription is as follows, translated into English:—"Samuel Finkez Breese Morse inhabited this house from 20th February, 1830, to January, 1831, inventor of the writing electro-magnetic telegraph. He was born at Charlestown, 27th April, 1791; died at New York 2d April, 1872."

—— **MAYOR HARRISON**, of Chicago, is engaged in a war upon telegraph poles, which have been prohibited by the city council within the corporation limits. By his recent order, the Mutual Union, Board of Trade, and Chicago and Milwaukee wires were cut near the city limits The time in which the Mutual Union could maintain poles in the city expired on March 1. The Western Union limitation will be reached about two months hence.

—— **A BUILDING** for the Western Union Telegraph Co , in course of erection at Buffalo, has supports for 1,100 wires upon the roof. To ca ry these wires into the various rooms of the building, 150,000 holes will have to be bored three-eighths of an inch in diameter, and most of them through wood four inches thick. This is equal to one continuous hole 600,000 inches, or over nine miles long A separate job for boring this nine mile hole has been let.

—— **MR. J. N. GEORGE**, of the late firm of Stearns & George, electricians, and also, formerly manager of the Telephone Despatch Co., has lately established an agency for the introduction of the Fuller Electrical Co.'s light into the States of Maine and New Hampshire, his headquarters being at No. 37 Pearl Street, Boston. Mr George brings to his new work a thorough and practical knowledge of electricity—the result of a long business experience in this field of science.

—— **SOME ENGLISH UNDERGRADUATES** who had been in labor with a new practical joke, at length brought it forth and christened it the telegraph joke. At half hour intervals, throughout the night, they telegraphed to a friend in Jersey, asking after his health and how he liked existence in Jersey. This was, no doubt, very amusing to the jokers, but the luckless "jokee" did not enjoy it all; for his father, who couldn't get a wink of sleep, disinherited him on the spot, declaring that only a bad son would have such a pack of fools for his friends.

—— **AMONG THE TELEPHONE** stories floating about, is the following: An old man would not believe he could hear his wife talk a distance of five miles by telephone. His better half was in a country store several miles away, where there was a telephone, and the skeptic was also in a place where there was a similar instrument, and on being told how to operate it, he walked boldly up and shouted: "Hello, Sarah!" At that instant lightning struck the telephone wire and knocked the man down, and as he scrambled to his feet, he excitedly cried, "That's Sarah, every time!"

—— **A GENTLEMAN** in Danielsonville, Connecticut, whose favorite dog enjoys following his carriage, by accident left the animal some miles from home. The people recognizing the dog, shut him in the house over night. The next morning a voice asked, through the telephone: "Have you lost a dog?" "Yes; where is he?" Voice: "Call him." He did so. The telephone was put near the dog, when he recognized his master's voice, and, in his dog way, manifested joy, licking the instrument and jumping about, eager to answer the call.

—— **THE** *Chicago Times* says, that a remarkable electrical phenomenon manifested itself, on the line of the Union Pacific Railway, recently, between North Platte and Sidney, Neb. The influence, however, was felt perceptibly beyond those points. The rails were surcharged with a current of electricity, moving from west to east to so high a degree that hand cars standing on the track were impelled at a fair rate of speed by it. One hand car at Brule got away from the section men next east. The influence of the current was felt by many persons along the track, and no little excitement prevailed during its continuance.

—— **AN INCANDESCENT LAMP** was recently made which contained an imperfection, which consisted of a small copper wire connecting the two poles When the lamp was put in use, this copper was volatilized and condensed, on the interior of the glass globe Ordinarily it appears to be a highly burnished copper knob, worthy of a place at the head of a drum-major's baton, but, on placing the lamp before a strong light, the copper is so thin, that objects can be distinguished beyond the lamp; in this manner the copper appears of a greenish hue. This deposit is noticeably thinner in the plane of the carbon filament, the lines are so sharply defined as to resemble a shadow.

—— **A PENNSYLVANIA COURT** has decided that the transfer of the credits and debits of accounts by telephone is as valid as that by word of mouth, in which there is no actual evidence in writing of the transaction

—— **WHEN THE EMPEROR WILLIAM'S** brother died the sudden cessation of all court festivities had a seriously ill effect upon the health of His Majesty, as he requires constant pleasurable excitement to counteract the strain of state duties. The court doctors and other attendants were driven to their wits' end to find some amusement for him that would be in accordance with etiquette. At last they hit upon the idea of getting up a series of scientific lectures The first discourse was by Dr Werner Siemens, on the electric elevated railroad, which he intends to build in Berlin The Emperor and his family attended, and showed great interest in the lecture, and the end aimed at by the doctors was thus fully reached.

—— **A WASHINGTON** despatch to the *Post*, March 22d, states: R. G. Dun, President of the Overland Telephone Company, is here. He says the company are at present only experimenting, but so far the experiments have been satisfactory. Every test imaginable has been applied, and the company, as well as electricians, are highly gratified with the result. Mr. Dun said that the company do not intend to build lines of their own, but will hire the privilege of using their invention and the instruments to telegraph companies. He says that one of the wires of the Baltimore and Ohio Company has been secured to test further the invention between this city and New York, and within a few days, probably this week, the two cities will be in telephonic communication,

Myron L. Baxter, the inventor, was found at his desk in the Surgeon-General's office. He says that he has not yet finished the experiments of long distance talking, but he has a wire running from his laboratory for a distance of five miles, and he says that over this wire he can hear a whisper spoken at a distance of seventeen feet from the transmitter. The great difference between the Blake transmitter and his invention, Mr. Baxter says, lies in the fact, that while there is no doubt that the Blake instrument could be so adjusted as to admit of a whisper, spoken several feet distant, being heard over the entire line, if the speaker change his voice to a shout it would so agitate the diaphragm that nothing could be heard. With the Baxter transmitter, on the other hand, the tone of voice would not make any difference at the other end. Mr. Baxter says that he has experimented with electricity for twenty-five years.

—— **THE LONDON** *Electrician* gives the following information with reference to the electric exhibition which it is proposed to hold in Vienna, this year It appears that his Imperial Highness the Crown Prince Archduke Rudolph, of Austria, has consented to become a patron of the exhibition, and takes great interest in it. His Majesty the Emperor, has, through Prince Hohenlohe, given an order to Carl Giani, for the production of a very handsome pavilion to be shown at the exhibition It is intended to drape the interior of this pavilion with rich hangings and embroideries, and to light it up by means of different systems of electric lighting, so as to show the adaptability of the electric light for the purpose, and also to afford a means of comparison between various systems. The extent which the exhibition is likely to reach, may be estimated by the fact, that the motive power which will be required, has been fixed at 1,000 h.p. About 700 h.p. is intended to serve for lighting the exhibition buildings and grounds. The boilers and engines employed will, in the majority of cases, be of the fixed type, although portable boilers and engines will not be excluded. All boilers and engines of whatever type, will be objects of exhibition. It has been proposed to arrange the boilers and steam engines as they would be if erected for permanent work, and so that they may be easily inspected by visitors. The machinery department will thus offer a good opportunity to engineers of making valuable comparisons. Although such an arrangement will considerably add to the expenses, nevertheless, the commission has consented to sacrifice a greater amount of money in order to secure an opportunity of general instruction, and thus hasten the solution of the important question—how to construct boilers and engines for electric lighting purposes.

—— A LONDON COTEMPORARY says: M. Shulachenko, who managed the Russian military telegraph during the Kulja expedition, communicates to the Russian Physical Society, the following results of his experiments with Siemens' telephones:—At a distance of 93 miles, music, singing and speaking were heard quite distinctly; at 130 miles, conversation was difficult—it was necessary to shout loudly, and those who received messages had to display a great sensibility of ear; but it was possible to have conversation even at a distance of 212 miles. When six pairs of telephones were put side by side, having each its wire, and the wires not being connected with one another, the conversation on one of them was heard on all the others. When the connecting wire of one pair of telephones was broken, the conversation on this pair was heard on the next pair of telephones, the wire of which was in good state.

—— INDUCTION COILS, Portable Batteries, and Electric Lights, was the subject of a recent paper read by Mr Charles J. Clark, before the Glasgow Philosophical Society The London *Electrician* says, that he began by describing an apparatus he had invented for lighting gas by means of electricity. He then proceeded to show how, in the course of his investigations, he had discovered that by the use of iron wire interlaid with cotton, he had succeeded in producing a perfect induction coil, greatly less in size and at little more than half the cost of the coil formerly in use He next showed how by using a similar coil, a small portable battery had been constructed, which could be utilized for many practical purposes, as, for example, in the ringing of bells, or the production of lights from small incandescent lamps. In illustration of the latter use, a gentleman, by whom the author of the paper was accompanied showed, an electric light burning, in his scarf pin, the electricity being supplied from a small battery carried in his waistcoat pocket. At the close of the paper, Sir William Thomson paid a high compliment to Mr. Clark for the industry and perseverance he had shown in perfecting his valuable inventions. The improvements he had made in portable batteries were of the greatest importance. He himself had been experimenting for years in the same direction with exceedingly little result, and he had often wished for a small portable battery such as he now saw realized. Setting aside such applications of the incandescent lamp as the placing of it in a gentleman's shirt pin, or in the hair and tresses of ladies for the amusement of the public, as by the fairies in *Iolanthe*. Mr. Clark had shown how it could be turned to important practical uses. A railway traveler might, for example, have a lamp which would burn for an hour, which was as long as any one should read in such circumstances, and it would also be useful during the night or in the sick room, rendering unnecessary the objectionable practice of keeping gas on the peep, or of striking lucifer matches. In reply to a question, Mr. Clark said he understood that some explosions had taken place with the gas lighter, at the works of Mr. Crum, of Thornliebank. He had since, however made such modifications in the apparatus as would render explosions in future impossible Mr. Thomas Gray next read a paper on a new seismographic apparatus, to be used at Tokio, Japan, in recording the time of occurrence of, and the horizontal and vertical motion during an earthquake.

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MESSRS. BURKE, FRASER & CONNETT'S *Quarterly Circular* of information and advice about patents and inventions for March, published for the free use of their clients, contains valuable articles on "Patents in Germany"; "Value of Germany as a Field for Invention"; "Governmental Policy in Patent Law"; "Bad Policy of Imposing High Fees on Inventors"; "How Patents Should be Granted"; "Ignorance of Newspaper Writers About Patents," &c., &c, See advertisement in another column

RECUEIL DE QUELQUES MEMOIRES, by Dr. Donato Tommasi. These papers were published in *Cosmos-les Mondes*, and refer for the most part to the chemical action of electricity. "Relation between the electro-motive power of the pile, and the calorics of water decomposition" and some short remarks on the electrolysis of water by carbon electrodes, form suggestive contributions to the great and, as yet, almost unexplored field of electro-chemical science. Dr. Tommasi, who is a most distinguished chemist, has written extensively on this and kindred subjects, and there would seem good reasons for believing that much that is now involved in mystery, both in chemistry and electricity, may be explained from such experiments. That there are great possibilities in this direction hardly admits of a doubt—in fact, our working electricity is now generally furnished by chemical action.

FROM the new edition of Messrs. Geo. P. Rowell & Co.'s AMERICAN NEWSPAPER DIRECTORY, which is now in press, it appears that the newspapers and periodicals of all kinds issued in the United States and Territories now reach the imposing total of 11,196. This is an increase of 585 in twelve months Taking the States one by one, the newspaper growth in some is very considerable. The present total in New York State, for instance, is 1,399—a gain of 80 in the past year. The increase in Pennsylvania is 48, the existing number being 943. Nebraska's total grew from 175 to 201, and Illinois' from 890 to 904. A year ago Massachusetts had 420 papers; now the number is 438. In Texas the new papers outnumbered the suspensions by 8, and Ohio now has 738 papers instead of 692. The most remarkable change has occurred in the Territories, in which the daily papers have grown from 43 to 63, and the weeklies from 169 to 243—Dakota being the chief area of activity. The number of monthlies throughout the country grew from 976 to 1,034, while the dailies leaped from 996 to 1,062. The figures given above are exclusive of Canada, which possesses a total of 606. It is interesting to note that the newly settled regions of the Canadian North-West are productive of newspapers as well as of wheat, for the number of journals issued in Manitoba was nearly doubled during the year.

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PATENTS FOR FEBRUARY AND MARCH, 1883.

FEBRUARY 20th.

272,811 Electric-arc Light. J. A Wetmore, Concord, Mich.
272,441 Electric Underground Conductor. R. M. Hunter, Philadelphia, Pa.
272,833 Electric Wires, System of Laying Subterranean Lines of. J. T. Goodfellow, Philadelphia, Pa.
272,792 Electrical Currents, Metallic Circuit for. S. D. Strohm, Philadelphia, Pa.
272,790 Electro-magnetic Regulator. R. H. Tucker, East Orange, N. J.
272,659 Insulated Electric Conductor. A. A. Cowles, New York, N. Y.
272,660 Insulated Electric Conductor. A. A. Cowles, New York, N. Y.
272,484 Railway Signal, Electric. E. L. Orcutt, Somerville, Mass.
272,839 Railway Signal and Switch System; Electric Interlocking. J. K. Knight, New York, N. Y.; and W. H. Baker, Brooklyn, N. Y.
272,724 Ships and the Rate of Currents, Electric Log or Apparatus for Ascertaining the Speed of. R. M. Lowne, East End, Finchley, County of Middlesex, England.
272,774 Telegraph Cable. N. M. Rittenhouse, Baltimore, Md.
272,524 Telegraph Wire Coupling. G. Brott, Waterford, N. Y.
272,645 Telegraphs, Signaling Apparatus for District and Fire Alarm. T. A. Casey, New York, N. Y.
272,505 Telephone Exchanges, Alarm Signal Apparatus for. E. A. Wo.lk, Springfield, Mo.

MARCH 6th.

273,565 Car Brake, Electric. D. J. Macpherson, Sioux Falls, Dakota.
273,534 Clock, Electric. D. F Sweet, Hastings, Mich.
273,622 Door Opener, Electrical. A. T. Smith, New York, N. Y.
273,291 Electric Force, Apparatus for Regulating the Transmission of. M. Levy, Paris, France.
273,487 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
273,488 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
273,406 Electric Machines, Air Blast Attachment for Commutators of Dynamo. E. Thomson, New Britain, Conn.
273,259 Electric Wires, Binding Screw for. E. C. Coolidge, Boston, Mass.
273,3 5 Electric Wires, Underground Conduit for. W. Plankinton, Milwaukee, Wis.
273,429 Electrical Conductor Coupling. P. R. Allen, Southwark County of Surrey, England.
273,493 Electrical Generator Engines, Valve Gear for. T. A. Edison, Menlo Park, N. J.
273,4 1 Electrical Generators, Regulator for Driving Engines of. T. A. Edison, Menlo Park, N. J.
273,329 Electrical Transmission of Power, Controlling the. E. Weston, Newark, N. J.
273,598 Electrode for Secondary Batteries. W. S. Platt, Waterbury, Conn.
273,593 Insulated Electrical Conductor. W. R. Patterson, Chicago, Ill.
273,592 Insulating Substances, Filling Telegraph Cables with. W. R. Patterson, Chicago, Ill.
273,336 Lamp, Electric-arc. G. D. Allen, Brooklyn, N. Y.
273,554 Lamp, Incandescent Electric. H. Lea, Birmingham, County of Warwick, England.
273,485 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
273,486 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
273,366 Lamp, Incandescing Electric. J. S. Kelso, Jr., Stamford, Conn.
273,494 Railway, Electrical. T. A. Edison, Menlo Park, N. J.
273,377 Railway Signal, Electric. C. J. Means, Boston, Mass.
273,490 Railway System, Electro-magnetic. T. A. Edison, Menlo Park, N. J.
273,489 Railway Turn-table, Electric. T. A. Edison, Menlo Park, N. J.
273,492 Secondary Battery. T. A. Edison, Menlo Park, N. J.
273,374 Telegraph, Fire and District. T. D. Lockwood, Malden, Mass.
273,264 Telegraph Sounder. W. E. Davis, Jersey City, N. J.
273,563 Visual Indicator, Electrical. J. W. Mackenzie, New York, N. Y.

MARCH 13th.

274,023 Car Brake, Electro-magnetic. H. S. Park, Henderson, Ky.
273,739 Electric Battery. P. Jablochkoff, Paris, France.
274,074 Electric Testing Apparatus. C. J. H. Woodbury, Lynn, Mass.
273,859 Electrical Conductors, Junction Box and Connection for. J. Kruesi, Brooklyn, N. Y.
273,823 Electrical Distribution, System of Underground Conductors for. T. A. Edison, Menlo Park, N. J.
273,887 Fence and Telegraph Post, Iron. L. Petrequin, Detroit, Mich.
273,751 Galvanic Battery. L. D. McIntosh, Chicago, Ill.
273,888 Lamp, Electric-arc. L. Piette and F. Krizik, Pilsen, Austria-Hungary.
273,704 Lamp, Incandescent Electric. A. Bernstein, Boston, Mass.
273,714 Magneto-electric Signaling Apparatus. T. A. Edison, Menlo Park, N. J.
274,082 Secondary Battery. C. F. Brush, Cleveland, Ohio.
273,855 Secondary Battery. N. S. Keith, New York, N. Y.
273,810 Telegraph Printing. W. J. Burnside, Hilcot Court Road, Lower Norwood, County of Surrey, England.
273,728 Telegraphic Receiving Instrument. E. M. Hamilton, New York, N. Y.
274,075 Telephone Transmitter. R. D. Woodworth, Orange, N. J.

MARCH 20th.

274,325 Clock, Electric. V. Himmer, New York, N. Y.
274,445 Clock Escapement, Electric, A. W. Gray, New York, N. Y.
274,323 Clocks, Circuit Controller for Electric. V. Himmer, New York, N. Y.
274,324 Clocks, Circuit Controller for Electric. V. Himmer, New York, N. Y.
274,371 Electric Current Regulator. C. G. Perkins, Camden, N. J.
274,150 Electric Currents, Cut-out for Dangerous. F. A. Swan, and C. B. Bosworth, Boston, Mass.
274,151 Electric Cut-out. F. A. Swan, and C. B. Bosworth, Boston, Mass.
274,101 Electric Motor. J. B. Atwater, Chicago, Ill.
274,213 Electrical Conductors, Underground Conduit for. H. R. Meyer, Liverpool, County of Lancaster, England.
274,290 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
274,452 Galvanic Batteries, Circle Switch for. H. Lowe, Brooklyn, N. Y.
274,110 Galvanic Battery. F. De Lalande, Paris, France; and G. Chaperon, Mines, D'Alosno, Spain.
274,181 Gas for Electric Lights, Apparatus for Substituting. P. B. Delany, New York, N. Y.
274,296 Incandescents, Manufacture of. T. A. Edison, Menlo Park, N. J.
274,297 Lamp Cut-out, Electric J. H. Elfering, Chicago, Ill.
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274,370 Lamp, Electric-arc. C. G. Perkins, Camden, N. J.
274,413 Lamp, Electric-arc. E. Thomson, New Britain, Conn.
274,427 Lamp Holder, Incandescent. E. Weston, Newark, N. J.
274,295 Lamp, Incandescent Electric. T. A. Edison, Menlo Park, N. J.
274,294 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
274,212 Telegraph and Semaphone Signal. W. W. McLellan, Newcastle, New Brunswick, Canada.
274,112 Telegraph Apparatus. G. D'Infreville, New York, N. Y.
274,300 Telegraph Printing. S. D. Field, New York, N. Y.
274,416 Telegraph Printing. H. Van Hoevenbergh, Elizabeth, N. J.
274,417 Telegraphy, Dynamo. H. Van Hoevenbergh, Elizabeth, N. J.
274,352 Telephone, Receiving. J. A. Maloney, Washington, D. C.
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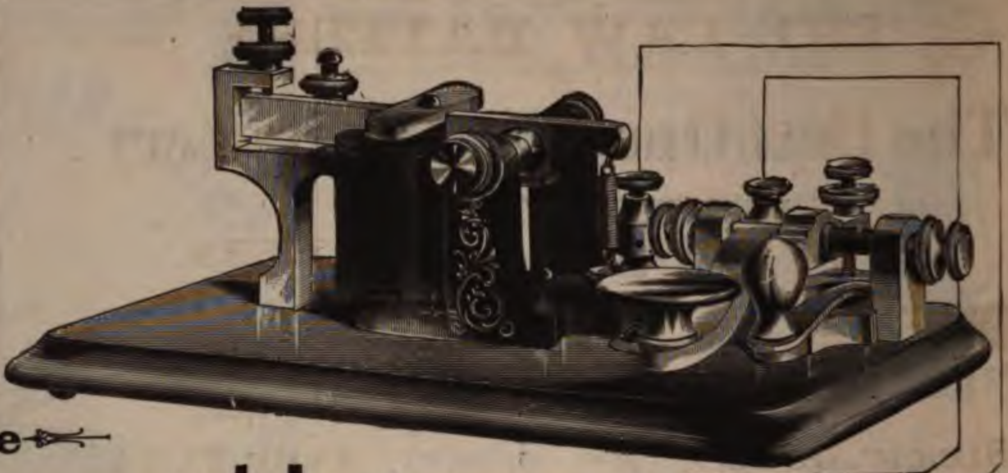

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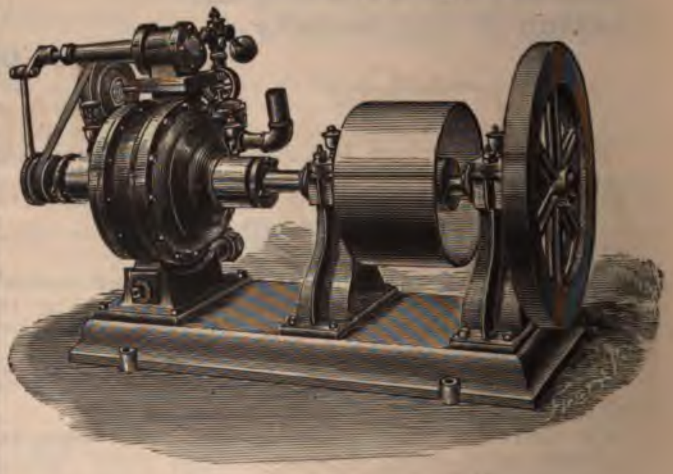

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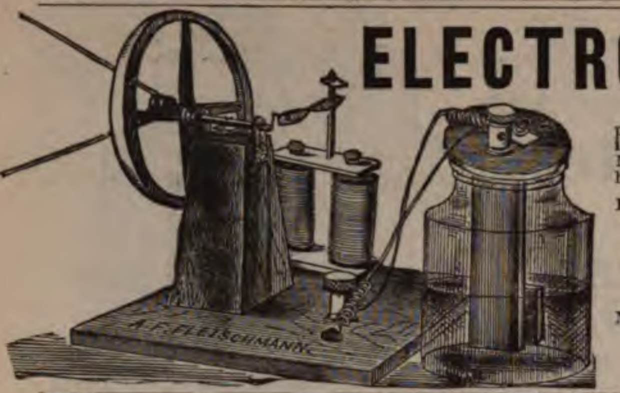

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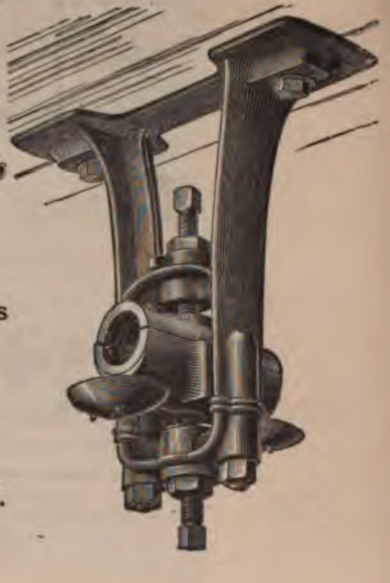

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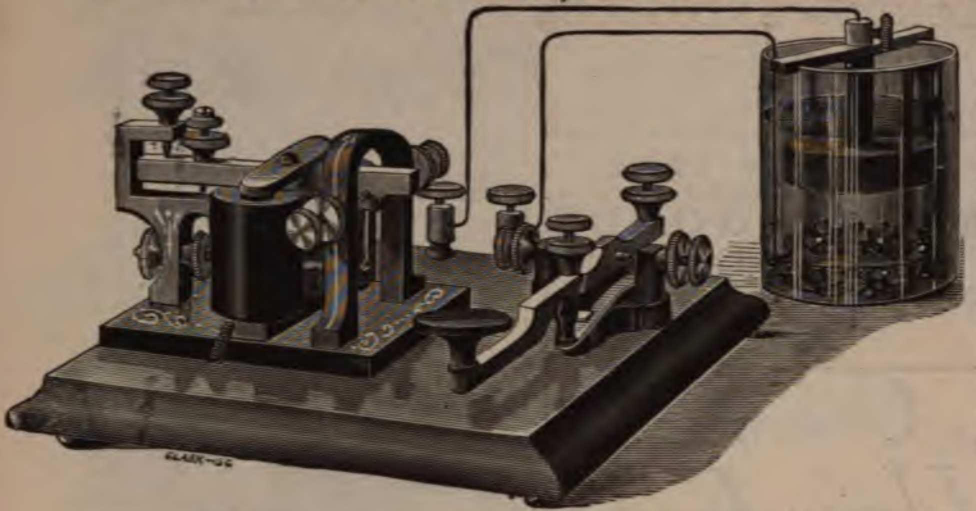

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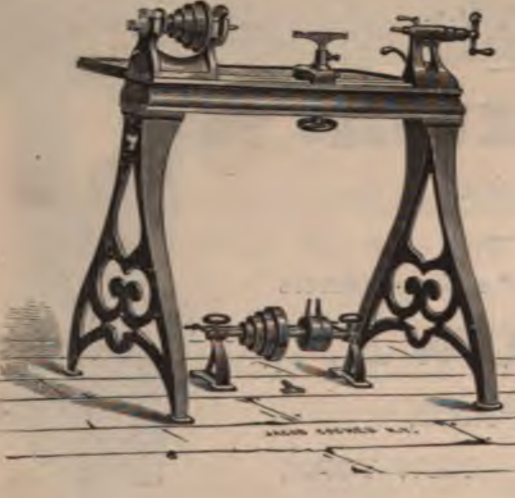

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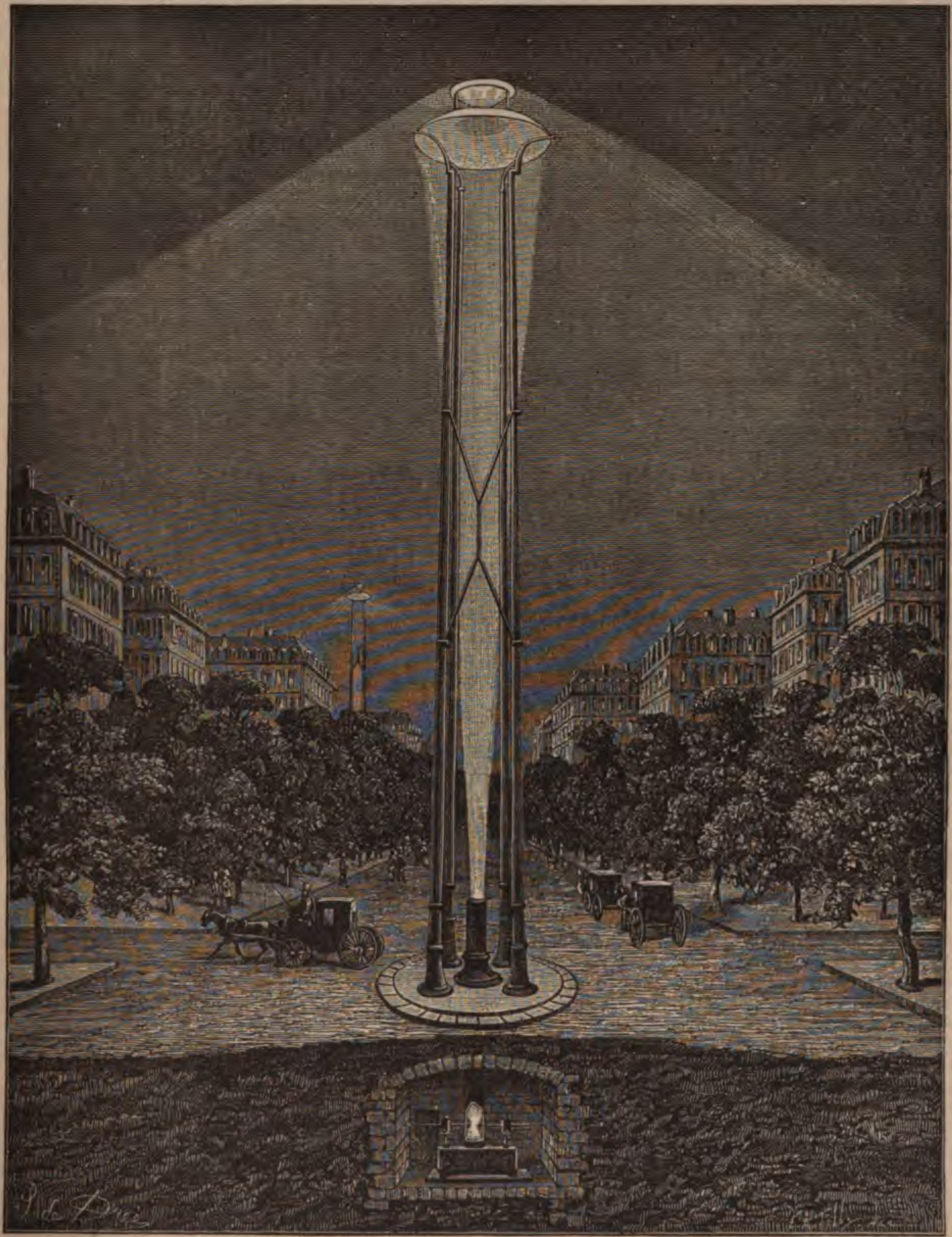

PARTZ'S SYSTEM FOR STREET LIGHTING.—See page 126.

STREET LIGHTING—THE PARTZ SYSTEM.

THE illumination of our streets is yet far from perfect; electricity has made us rather desirous of better things, than satisfied with what we have. It is nowhere disputed, however, that here electricity has the field entirely to itself, and it is simply a better method of appliance, and not another agent which is being sought for. Although it has been hitherto regarded as a truism, that "all light comes from above," it may be possible that electric illumination will shoot upwards, lighting laterally, and then be again reflected downwards and laterally, by means of suitable apparatus. The accompanying illustration is very suggestive of the possibilities in this way. As at present most of the electric light is lost at the height of the lamp; but with the Partz system the surface of the ground would be well illuminated. An electric regulator is placed beneath the ground, and the rays are shot through an enameled hollow cylinder some 10 feet in length. The luminous body forms an inverted cone, and the rays are again diffused from a reflector.

The producing apparatus being concealed, it is claimed that the eyes will be less dazzled, and the apparatus is also capable of being easily regulated and managed.

No practical exemplification of the system has yet been shown, and some objections have been made against it, but we believe the idea a very good one, and one which may solve the question of illumination in some of its aspects.

RECENT TELEPHONIC AND MICROPHONIC RESEARCHES.

INVESTIGATIONS OF THE ELECTRICAL RESISTANCE OF CARBON CONTACTS, BY MR. SHELFORD BIDWELL—MR. JAMES MOSER'S TELEPHONE BATTERIES—MR. D'ARSONVAL'S NEW MAGNETO-ELECTRIC RECEIVING TELEPHONE.

SOON after the invention of the Bell telephone, the Edison carbon transmitter and the Hughes microphone, three true inventions of the first order, there sprung up an incalculable number of inventions similar to, if not identical with these original creations, and the telephones and microphones of Messrs. X. Y. and Z. could soon be counted by hundreds. This is a natural phenomenon, following every successful invention either in the domain of science or that of industry; it is the tribute of endorsement and approval compelled by success.

Happily, there are among these later inventors (second-hand inventors, one might call them), some modest workers who acknowledge their obligations to the original invention, and who occupy themselves solely in perfecting it, without unduly exaggerating the merit of their own efforts; some of them investigate in a scientific manner the mechanism of the phenomena down to the smallest details, varying all of the elements of the problem in order to arrive at the value of the influence of each; while others improve the arrangement and construction of the apparatus in order to make them better fitted for practical use, extend their uses and applications and solve the problems arising daily in the development of these applications. It is for some of the researches and apparatus of this class, that we to-day assign a space in the columns of *La Nature*.

We will first direct our attention to microphonic transmitters. Since Edison and Hughes, the innumerable battery transmitters designed by inventors have consisted of carbon contacts, varying in their arrangements, their number and their grouping. Some trials made with metallic contacts, and semi-conducting powders, have not produced very brilliant results, and have not, up to the present time, received any practical applications. Mr. Shelford Bidwell has studied the phenomenon in all its details, and presented the results of his researches to the Royal Society of London, in January last. His experiments had for their object, the quantitative determination of the influence of varying pressure and varying quantity of current, on the resistance of carbon and metallic contacts. As we cannot reproduce this work *in extenso*, we give herewith the results of these researches, such as Mr. Shelford Bidwell has summed up in his communication.

FIRST.—CARBON CONTACTS.

Changes in pressure produce proportionately greater changes in resistance when the pressure is slight, than when it is great. Variations in resistance are relatively greater, with feeble currents than with powerful ones.

Changes in the intensity of the current produce proportionately greater changes of resistance with feeble currents and light pressures, than with intense currents and great pressures.

When the resistance of a carbon contact has been diminished by an increase of pressure, it recovers approximately its former value when that pressure ceases. The passage of a current whose intensity does not exceed a certain limit, depending on the pressure, produces a diminution of the resistance as much greater as the current is more intense. When the current exceeds a certain limit, the resistance of the contact is then augmented permanently, and in a greater degree as the pressure itself is greater. Except in the cases of special arrangements which maintain the current constant, the diminution of resistance which results from the augmentation of pressure is greater than that due to the increase of pressure alone; it is also partly due to the augmentation of the intensity of the current. It is not proved that the diminution of resistance, which is the result of the augmentation of current, should be attributed to the effect of temperature.

SECOND.—METALLIC CONTACTS.

In the case of bismuth, and probably also in the case of other metals, the resistance is as much greater for a given pressure, as the current is more feeble.

An increase in current is accompanied by a diminution of resistance, and if the current is brought back to its original intensity, the resistance varies but little, and never recovers its first value.

An increase of pressure produces a greater diminution of resistance with feeble than with great pressures, and with feeble currents than with intenser ones.

The resistance diminished by an increase of pressure, does not return to its original value when the excess of pressure is removed.

The very different manner in which carbon and metallic contacts behave under variations of pressure and of current, perfectly explain the superiority of the former, and their exclusive use in the transmitting microphones in use at this day. The very simple principles brought to light by the methodical experiments of Mr. Shelford Bidwell, permit the grouping, more scientifically and rationally, than has ever been done before, of multiple contacts, in order to place them under the best conditions for working, and to utilize in the highest attainable degree their variations of resistance in each particular case, according to the nature of the source of electric energy, the nature of the sounds to be transmitted, and the length of the line—elements which have so great an influence on the variations of resistance of the contacts and the intensity of the current which traverses them.

We recall the telephonic theatrical audition experiments, made by Mr. Clement Ader, at the Exposition of Electricity in 1881—experiments which were, without contradiction, the greatest success of the exhibition. The transmission was effected by the aid of 10 Ader transmitters, 10 metallic circuits (20 wires), and 80 Ader receivers, which allowed 40 persons to listen at one time. Mr. James Moser proposes to augment the number of receiving telephones and to diminish the number of lines, and has reached the following result: to transmit speech and music to 100 telephones at one time, with the aid of a single line wire. The experiments took place, during last autumn, between the Hippodrome and the office of the *Société Internationale des Téléphones, Place Vendôme.* Mr. James Moser has obtained this result by constructing true batteries of transmitters, induction coils and receiving telephones, the number and grouping of which are varied at will, according to the nature of the line, the number of receivers, etc. The diagram herewith, see Fig. 1, shows how the apparatus was arranged for the experiments made between the *Hippodrome* and the *Place Vendôme*:

Translation of the text accompanying Fig. 1: TERRE—"GROUND."

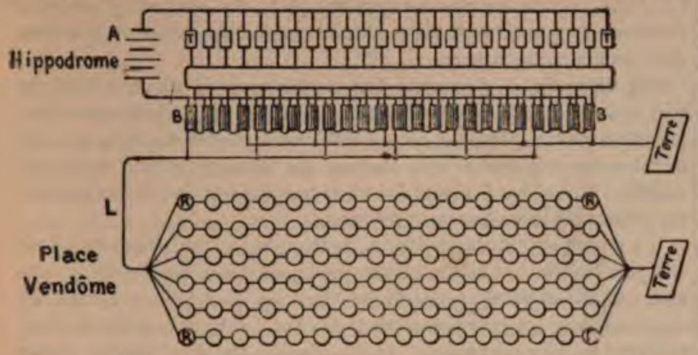

FIG. 1.—TELEPHONIC EXPERIMENTS, MADE BY MR. JAMES MOSER, BETWEEN THE HIPPODROME AND PLACE VENDÔME.

A, Faure accumulators, Reynier model. T, Ader transmitters (25 connected in multiple arc). B, Induction coils. The primary wires of the 24 induction coils are connected in multiple arc to the circuit of the accumulators and the Ader transmitters; the secondary wires form 6 derivations of 4 coils in tension, connected on one side to the ground, and on the other to the line, so that the combined currents of 6 groups of 4 secondary coils go to line and earth. L, Line wire R, Ader receivers, connected in 6 groups, connected in multiple arc, each consisting of 16 receivers, in series.

The source of electricity is composed of Faure accumulators, of the Reynier model, the number of which can be varied at will by a commutator; the transmitters are of the Ader pattern, to the number of 25, connected in multiple arc. In the diagram, the transmitters are shown ranged side by side, but in practice, they are disposed in 5 vertical groups of 5 transmitters, on a board about 3 feet wide, placed above the orchestra at the Hippodrome, in a slightly inclined plane. Each Ader transmitter is composed of 10 pencils, disposed in two series, in tension of 5 carbons in quantity; that is to say, 20 contacts for each transmitter (4 in tension, 5 in quantity), making, in all, 500 carbon contacts, influenced simultaneously and synchronously, by the same vibrations. The circuit of the accumulators, and of the 25 transmitters, is closed on the primary wires of 24 induction coils, identical with those used by the *Société Génerale des Téléphones*, connected in quantity.

The total quantity of current in the primary circuit was 24 ampéres,—that is, 1 ampére per induction coil, and about 1 ampére per transmitter. The 24 secondary coils of the 24 induction coils, are grouped in 6 derivations of 4 bobbins in tension, and connected on one side to the ground, and on the other side to the single wire which established the communication between the Hippodrome and the office in the Place Vendôme, passing through the central office in the *Rene-Neuve des Petits Champs.* The 96 receiving telephones are grouped in 6 derivations each, including each 16 receivers in tension.

The connecting of all the transmitters in quantity is dictated by this consideration; demonstrated, theoretically and practically, by Mr. Moser, that the variations in the primary current, and, in consequence, those of the induced current, are proportional to the intensity of the current, which it is desirable to make as great as possible, without exceeding, for each microphonic contact, a certain intensity, above which sparks and sputtering will be produced A current of 1 ampére per transmitter, corresponds to one-fifth ampére per contact, which is a good average standard for transmitters of this type. We remark, in passing, that Mr. James Moser has arrived, by a way and through considerations entirely different, and in a perfectly independent manner, at putting in practice the principles laid down by Mr. Shelford Bidwell, as a result of his experiments with microphonic contacts.

For the grouping of the secondary coils and the receivers, one would be led, on the one hand, to connect all the apparatus in tension, to overcome the resistance of the line; and, on the other hand, to adopt the contrary method, by connecting them all in quantity, in order to use a smaller potential, which reduces the effect of defective insulation, and of electro-static phenomena. In practice, a middle course is adopted, varying with the nature of the line on which the transmission is to be effected.

The same system has enabled Mr. Moser to telephone between Paris and Nancy, on an ærial line of about 219 miles length; but, by grouping the secondary coils in a slightly different manner, three derivations only are used, each including eight coils in tension, and two Goloubitzky telephones in tension are used at the receiving station.

In the first case, the effects of induction due to the action of other lines are, not destroyed, but enfeebled to a great extent, because the intensity of the induced currents is only a very small fraction compared to that of the currents which act effectively on the receivers, and which originates in the multiple transmitter devised by Mr. Moser. In the case of the ærial line from Paris to Nancy, with two receivers, the induction can only be overcome by using a metallic circuit.

Receiving telephones have also received some improvements during recent times. Among these improvements, we ought to mention those which Mr. D'Arsonval has brought to magneto-electric receivers, and which have resulted in the construction, by Mr. Leczensky, of the apparatus represented in Fig. 2.[*]

Mr. D'Arsonval recognizes that experience has shown that the principle of the Bell telephone should be preserved, but that, nevertheless, certain modifications could be adapted to this admirable instrument so as to augment its effects and facilitate its construction. The telephone of Mr. D'Arsonval has no other pretentions than to present some of these modifications. When a wire, traversed by a current either undulatory or interrupted, is placed in the vicinity of a magnet, its action on the magnetic field is as much greater, as the wire is placed in a part where the magnetic field is more intense. The best effect will be obtained by immersing the wire completely within the field, and by bringing the poles as close to the wire as possible, in order to augment the intensity of the field in the space which the wire occupies.

To arrive at this result, and to place the wire in the space where the field is most intense, Mr. D'Arsonval has made an annular magnetic field, as in the Nicklés' electro-magnets, taking for a centre one of the poles of the magnet, whilst the other pole surrounds the coil as a wide ring; the bobbin is placed in the annular space thus formed between the two poles, as is represented in Fig. 2. The box which supports the diaphragm is simply held between the magnet and the core; it is sufficient to screw on the embouchure in order to hold the diaphragm. Two flexible cords carry the current to the coil, without any external screw-posts. The complete telephone weighs only 350 grammes,[†] and has as much power as a Gower telephone of much greater weight; it transmits speech very clearly, without sensibly altering its *timbre*, on account of the small dimensions of the diaphragm. By adding a trumpet shaped ear-piece, it can be heard all over a room, provided a battery transmitter be used.

Mr. Leczensky also constructs the D'Arsonval telephones of Clemandot's compressed steel. As this metal can be magnetized without being tempered, and as the tempering has often the effect of changing the shape of the pieces, it follows that telephones of compressed steel are susceptible of a nicer adjustment than the same apparatus made of ordinary tempered steel. As it is constructed, the D'Arsonval telephone is very handy, very simple and quite portable, qualities which will, without any doubt, contribute to multiply the number of its applications.

E. HOSPITALIER, in *La Nature*.

—— ON THE 1ST OF JULY next, telephones will be attached to all telegraph offices in Paris, and to the chief offices in the provinces and the principal railway stations. The charge will be 25 centimes (nearly 2½d.) for five minutes' use. The telephones will also be extended to private houses, for an annual payment of 170 francs in Paris, and 200 in the provinces.

—— THE GAS COMMISSION, on the 19th of April, awarded the contracts for lighting the streets and public places of the city by electricity, for the year commencing May 1st, as follows:

The Brush Electric Light Company will light Broadway and Fifth Ave. from Fourteenth to Thirty-fourth St, and parts of Fourteenth and Thirty-fourth Sts., at 70 cents per night for each light. The United States Illuminating Company will light the Battery, City Hall and Washington Parks, and Broadway from Canal to Fourteenth St., and Fifth Ave., from Washington Square to Fourteenth St., at 70 cents for each light per night.

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[*] See Vol. 1, page 287 of THE ELECTRICIAN, for illustration of this instrument.
[†] About ¾ lbs. Trans.

REIS'S TELEPHONE.

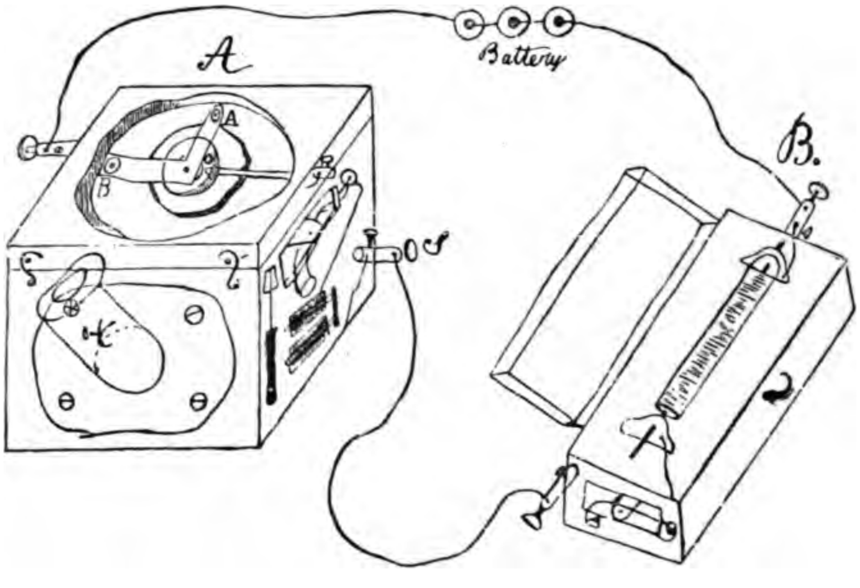
THE subjoined copy of an autograph letter from Ph. Reis to Mr. William Ladd, describing his telephonic apparatus, appears in the "Journal of the Society of Telegraph Engineers and of Electricians," for March.

[Copy.]

Institut Garnier,
Friedrichsdorf.

Dear Sir: I am very sorry not to have been in Frankfort when you were there at Mr. Albert's, by whom I have been informed that you have purchased one of my newly-invented instruments (telephons), though I will do all in my power to give you the most ample explanations on the subject. I am sure that personal communication would have been preferable, specially as I was told that you will show the apparatus at your next scientifical meeting, and thus introduce the apparatus in your country.

Tunes and sounds of any kind are only brought to our conception by the condensations and rarefactions of air or any other medium in which we may find ourselves. By every condensation the tympanum of our ear is pressed inward, by every rarefaction it is pressed outward, and thus the tympanum performs oscillations like a pendulum. The smaller or greater number of the oscillations made in a second gives us, by help of the small bones in our ear and the auditory nerve, the idea of a higher or lower tune.



Reis's Telephone.

It was no hard labor either to imagine that any other membrane beside that of our ear could be brought to make similar oscillations, if spanned in a proper manner and if taken in good proportions, or to make use of these oscillations for the interruption of a galvanic current. *However, these were the principles which guided me in my invention;* they were sufficient to induce me to try the reproduction of tunes at any distance. It would be long to relate all the fruitless attempts I made until I found out the proportions of the instrument and the necessary tension of the membrane. The apparatus you have bought is now what may be found most simple, *and works without failing when arranged carefully* in the following manner:

The apparatus consists of two separate parts, one for the singing station, A, and the other for the hearing station, B.

The apparatus, A, is a square box of wood, the cover of which shows the membrane, *b*, on the outside, under glass. In the middle of the latter is fixed a small platina plate, to which a flattened copper wire is soldered, on purpose to conduct the galvanic current. Within the circle you will further remark two screws; one of them is terminated by a little pit in which you put a little drop of quicksilver, the other is pointed. The angle, which you will find lying on the membrane, is to be placed according to the letters, with the little hole, *a*, on the point, *a*, the little platina foot, *b*, into the quicksilver screw, the other platina foot will then come on the platina plate in the middle of the membrane.

The galvanic current coming from the battery (which I compose generally of three or four good elements) is introduced at the conducting screw, near *b*, wherefrom it proceeds to the quicksilver, the movable angle, the platina plate, and the complementary telegraph to the conducting screw, *s*. From here it goes through the conductor to the other station, B, and from there returns to the battery.

The apparatus, B, a sonorous box, on the cover of which is fixed the wire spiral with the steel axis, which will be magnetic when the current goes through the spiral. A second little box is fixed on the first one, and laid down on the steel axis to increase the intensity of the reproduced sounds. On the small side of the lower box you will find the corresponding part of the complementary telegraph.

If a person sing at the station, A, in the tube, *x*, the vibrations of air will pass into the box and move the membrane above, thereby the platina foot, *c*, of the movable angle will be lifted up, and thus will open the stream at every condensation of air in the box. The stream will be re-established at every rarefaction. In this manner the steel axis at Station B will be magnetic once for every full vibration, and, as magnetism never enters or leaves a metal without disturbing the equilibrium of the atoms, the steel axis at Station B must repeat the vibrations at Station A, and then reproduce the sounds which caused them. ANY SOUND will be reproduced, if strong enough to set the membrane in motion.

The little telegraph which you find on the side of the apparatus is very useful and agreeable for to give signals between both of the correspondents. At every opening of the stream, and next following shutting, the station A will hear a little clap, produced by the attraction of the steel spring. Another little clap will be heard at station B, in the wire spiral. By multiplying the claps and producing them in different measures, you will be able, as well as I am, to get understood by your correspondent.

I am to end, sir, and I hope that what I said will be sufficient to have a first try; afterward you will get on quite alone.

I am, Sir,
Your most obedient servant,
Friedrichsdorf, 13, 7, '63. Ph. Reis.
To Mr. William Ladd.

—— *Engineering* states, that the details of an interesting examination into the interior of the liver, by aid of the electric light, has been brought before the Northumberland and Durham Medical Society, by Dr. T. Oliver, of Newcastle-upon-Tyne. An incision of the liver was made, and the interior of the cyst was lighted up by a miniature Swan lamp enclosed in a silver plated brass tube glazed at the end, inserted into the wound. The tube was 9½ in. long and 11/16 in. internal diameter. It was smeared with carbolized oil before being used, and carbolized glycerine may in future be used instead of glass for the window of the tube. The lamp was lighted after the tube was inserted, and Mr. Payne was perfectly satisfied that the lighting of internal cavities in this way will be very useful. He was able to see the internal walls of the cyst, and note the signs of disease. The Swan lamp used was about the size of a bean, and gave a light of two or three candles. The lamp is fed by two or three cells of Grove or Bunsen, and is kept cool by water circulating in narrow tubes round the bulb—a head of pressure being given to it by hanging the can or reservoir from the ceiling.

*HISTORIC NOTES ON THE TELEPHONE.**

BY J. J. FAHIE, MEMB. SOC. TEL. ENG. AND ELEC.

SEEING, of late, a good deal about the telephone in the pages of *The Electrician*, it has occurred to me that a few facts on its early history would not be uninteresting. I therefore give below such notes as I have been able to collect in the course of my researches in dusty tomes. Many of the references will, doubtless, be familiar to those of your readers who have studied the telephone ; but a few will, I think, be regarded as "facts not generally known."

Passing over the claim of the Chinese to the invention of the telephone as "not proven," we come to the year 1837, when Professor Page, of Salem, Massachusetts, observed the sound that was produced in iron by magnetization and demagnetization. This phenomenon was explained by De la Rive, of Geneva, in 1843, who showed that it was caused by the slight elongation of the iron which accompanies the act of magnetization—a fact discovered by Dr. Joule, in 1842. Page's receiver consisted of a bar of iron, surrounded by a coil of wire. These bars were of considerable dimensions, some as much as 3 feet long, and 1 inch to 2 inches diameter. With powerful currents, the sound emitted was heard as a click, and when these clicks were made to follow each other with sufficient rapidity, a certain note was produced whose quality depended, of course, on the number of clicks per second. By an automatic make and break arrangement, as a transmitter, Page obtained sounds sufficiently loud to be heard at a considerable distance.

The next step in the evolution of the telephone is claimed for Mr. Edward Farrar, of Keene, New Hampshire, U. S. His proposal was to transmit sounds of different pitches by the vibration of an armature of an electro-magnet. The *modus operandi* is thus described by the author himself, in a letter written in 1851, and which his friend, Mr. Brackett, published in the *Scientific American*, in 1879 : "Each reed of a melodeon is furnished with a small metallic point, which, while the reed is at rest, approaches near to the surface of mercury in a very small cup underneath the reed, into which the point dips when set in motion. The reeds are connected with one pole of a battery, and the cups with the other. The current is broken with each vibration of the reed. At the remote end of the wire is a temporary magnet, with an armature fixed upon a spring in near proximity to the magnet, and which is affected as a reed at the other end of the line is set in motion. The effect is, that the armature vibrates with the reed set in motion, and, as the pitch of a sound depends on the rapidity of vibration, it will be the same in the reed and armature. A tune on the instrument will, therefore, produce a tune on the armature. What may appear somewhat strange, several different tones may be heard when chords are struck upon the instrument. The object of my inquiry was this : If the current power could be varied by some slight variation of a vibrator, to be affected by the atmosphere as the tympanum of the ear is, the supposition is, that the sounds of the voice might be reproduced by the means stated above."

Professor Dolbear says, in his paper "On the development of a new telephonic system," read before the Society of Telegraph Engineers and of Electricians, March 23, 1882 : "Though Farrar spent some time in attempting to solve the problem of the transmission of speech by electricity, he did not succeed. He had some written communication with one of the foremost men of science in New England at that time (1851), as to whether such a device could be made, and as to its practicability, but the reply he received was so discouraging that he abandoned the attempt."

The next attempt was a musical telephone again, the invention of a M. Paterma, of Prague, about 1852. It was a keyed instrument, which, by means of an electro-magnet, set a small iron plate or armature in vibration as soon as the hand left the key. Each key gave a different note, and a similar instrument, at a considerable distance, was caused, by a connecting wire, to give out the same tones. This apparatus is described in Dingler's *Polytechnisches Journal*, for 1852 ; also in Böttger's *Polytechnisches Notizblatt* for 1853.

In the *Builder* for May 5, 1855, there will be found a reference to the submarine cable then just laid between Varna and Balaclava, in the course of which occurs the following remarkable passage : "It would not now be difficult, by some little further novelty of invention, to cause the reverberation of the very cannons themselves, as it were, to be transmitted, in the shape of electric vibration, through the 3,000 miles of intervening wire, and heard, in still continuous vibrations, finally communicated to some acoustic apparatus in the British houses of parliament ! Such is the close co-relationship of forces, that this is, literally, perfectly possible ; and, although it would not be precisely the sound of the cannons which our legislators would hear, it would actually be the vibratory reverberations of that very sound itself, for all sounds are vibratory forces, which reverberate into the electric interiors of material substances ; and some recent experiments have curiously illustrated this very point in physical science."

Our next reference is of a similar kind to the last, a mere expression of opinion, on theoretical grounds, of the possibility of transmitting the human voice to a distance by the agency of electricity. *Apropos* of this, M. le Comte du Moncel (*Exposé des Applications de l'Electricité*, Paris, 1857), has the following, which to-day reads strangely enough : "I did not wish to bring forward in the chapter on the electric telegraph a fantastic conception of a certain M. C. Boursel, who believes that it will be possible to transmit speech electrically, because it might have been asked why I had classed among so many remarkable inventions an idea that is not more than a dream." "The idea that is not more than a dream" is thus described in the same work : "Imagine that one speaks near a mobile plate, flexible enough not to lose any of the vibrations produced by the voice ; that this plate establishes and interrupts successively, the communication with a battery. You may be able to have at a distance another plate which would execute at the same time the same vibrations. It is true that the intensity of the sounds produced would be variable at the point of departure, where the plate is vibrated by the voice, and constant at the point of arrival, where it is vibrated by electricity. But it is demonstrable that this would not alter the sounds."

The next note is a mere newspaper paragraph, and is to the following effect : "The Abbé Laborde, in a paper read before the French academy, and printed in the last number of the *Comptes Rendus*, showed how vibrations may be transmitted and reproduced at a distance by electricity, April 14, 1860." Against the same name in Ronald's catalogue, we find the following entry : "Note on a New Electric Telegraph, whose indications are given by means of sound" (*Comptes Rendus*, XXI., 526, Paris, 1845).

The experiments of Professors Wheatstone and Helmholtz, in which were employed tuning-forks, in connection with electro-magnets, are so well known as to need only the briefest mention here ; we will, therefore, pass on to a consideration of the labors of Reis, who comes next in the order of time. As the back numbers of *The Electrician* contain all that can be said of Reis's *latest* improvements in telephony, his *earlier* labors, being not so well known, and not less interesting, will solely occupy us here.

According to a letter, which Dr. Messel, a former pupil of Reis, addressed in December, 1877, to Professor Barrett, of Dublin, Reis's first experiments date as far back as 1852. But at that time they ended in failure, and were not resumed until 1860, about which time the first published account of them appeared in a daily paper of Frankfort-on-Main.

"The first instrument," says Dr. Messel, "was of a most primitive nature. A bung of a beer barrel had a conical orifice cut through it, the smaller end being closed with the skin of a German sausage, which did service as a membrane. To this was fixed, with a drop of sealing wax, a little strip of platinum (or a platinum wire), representing the hammer of the ear, and which closed or opened the circuit precisely as in the instruments of a later date. The receiving instrument was a knitting needle, surrounded with a coil of wire, and placed on a violin, to serve as a sounding board. Some idea of the roughness of the main parts of the first telephone, can thus be formed. When first exhibited at Frankfort, it astonished every one, quite as much as the more perfect instruments of Bell now do. The apparatus here described has now passed into the hands of the telegraph department of the German government."

Reis gave his first public lecture in October, 1861, before the Physical Society of Frankfort-on-Main, an account of which is published in the annual report of that society for the year 1861. It is entitled, "Telephony by Means of Electric Currents." He describes the way in which he was led, from the study of the human ear, and the manner in which it receives the impression of vibratory movements, to the construction of an instrument similar in principle, which should reproduce musical tones, and even the sound of the voice in speaking.

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* From London *Electrician*.

A cubical wooden block was pierced by a conical opening, the smaller end of which was covered by a thin skin, and to the centre of this skin was fastened a narrow strip of platinum, joined to one end of a small voltaic battery. Close to, but not touching this strip, was a wire connected to the distant receiver, returning thence to the other pole of the battery. His receiver was still a simple knitting needle, surrounded with a coil of wire, and supported upon a resonant box. Speaking into the broad end of the cone, the membrane was thrown into vibration, and intermittent currents were sent to the distant receiver. Here the rapid magnetization and demagnetization of the iron core by the interrupted current, gave rise to a series of sounds. Here are his own words as to the performance of this early form of instrument: "I was able to make melodies audible to a numerous audience at the Physical Society of Frankfort-on-Main. Melodies were sung, not loudly, into my apparatus in a hospital about three hundred feet away from the listeners, care being taken that no sound could be heard by direct means, or by conduction along the wires. The sounds of various musical instruments were also clearly reproduced, as the clarionet, horn, organ-pipe, and even harmonium or piano, when the transmitter was placed on their sound boards, provided the tones were within a compass of about three octaves—F to f''. So far, articulation has not been reproduced equally well. Consonants, however, were in general pretty clearly heard, but not the vowels. The sound, in all cases, is of course much feebler than in the originating instrument."

Subsequently, Reis achieved greater success in reproducing articulation. In a report of Reis's telephone, by a M. Legat, Inspector of Telegraphs in Cassel, &c., published in 1862,[*] the following sentence occurs: "Melodies can be reproduced with astonishing certainty, whilst single words, in reading, speaking, &c, were less distinct, although the peculiar modulations of the voice in speaking, calling, interrogation, surprise, or command were clearly marked." The instrument described in this report is somewhat different from the earlier form. The diaphragm was a collodion film, and the contact-breaker behind it was lighter, and constructed in the form of an S-shaped lever, the longer arm of which was in contact with the membrane, while the shorter made and broke the circuit. There was no metal disc on the membrane, but the circuit was completed by means of the arm on which the lever delicately moved. The receiver, moreover, was a small horse-shoe electro-magnet, fixed horizontally to a sounding board. The rapid isochronous movement of a light keeper, adjusted by a spring before the poles of the magnet, reproduced the original sounds.

Still more success, as regards articulation, appears to have been achieved a little later; for, in a paper on Reis's improved telephone, published in Germany in 1863,[†] it is stated: "Particularly distinct was the reproduction of the scale. The experimenters could even communicate to each other words; only such, however, as they had already heard frequently." In confirmation of this may be added the following extract from a recent letter received from Dr. Messel: "There is not a shadow of a doubt about Reis having actually achieved imperfect articulation. I personally recollect this very distinctly, and could find you plenty of ear witnesses to the same fact."

Two or three years later, in 1865, a skillful instrument maker in Dublin, Mr. Yeates, showed to the Philosophical Society, in that city, a modification of Reis's telephone, wherein a near, though accidental, approach was made to the true principle of an articulating telephone—namely, the employment of a continuous electric current of varying strength This was obtained, though the primary object was different, by putting a drop of water, or a fragment of moistened paper, between the metal disc on the membrane and the adjacent platinum point, which completed the electric circuit. Articulation of an imperfect kind was thus obtained. Unaware of Reis's improvements, Mr. Yeates also employed a simple and a very effective form of electro-magnetic receiver, which deserves to be more widely known. Upon a light sounding box a little electro-magnet is supported by a brass pillar. A light iron keeper is fastened at one end, by a flat steel spring, to a wooden bridge, which can be raised and lowered by a screw. The distance of the keeper from the poles of the magnet can thus be adjusted with great nicety—a point of some importance. The ends of the wire round the coils are connected with binding screws, to which are joined the line wire leading to the distant receiver and the return wire. With this little instrument, an audience of a thousand people can easily hear musical airs sung into the transmitter, which may be many miles away.

In conclusion of this portion of our subject, we have to acknowledge our obligations to a paper on the electric telephones of Reis and Bell, contributed, some years ago, by Professor Barrett, to *Good Words*.

About the same time that Yeates, in Dublin, was introducing improvements into the Reis telephone (one of which—the water contact—would almost entitle him to a share in the discovery of the undulatory principle, since appropriated by Bell), an Italian mechanic, named Manzetti, appears to have designed an instrument for the same end. Unfortunately, we have no more information respecting this invention than is contained in the following extract from the *Petit Journal*, of Paris, November 22, 1865: "A new discovery, which will produce immense results in its application to the arts and industries, has recently been added to the numerous wonders of this century; it is the transmission of the sounds of the voice by telegraph. The author of this invention is Signor Manzetti, of Aosta, who is also the inventor of a celebrated automaton. He transmits words with the ordinary telegraph wire, and with an apparatus more simple than that which at present serves for despatches. Henceforth, two merchants may communicate, instantaneously, their business affairs between London and Calcutta, informing each other of their speculations, agreements, &c. A number of successful experiments have been made, which confirm the practicability of this invention. It also transmits musical notes, &c."

Our next note refers to a claim which is equally vague as the last, and rests upon still more slender foundations—to wit, the *ex post facto* statements of the claimant himself. In saying this, we do not, by any means, wish to insinuate that these statements are unworthy of credence. We give the paragraph as we found it in the *Journal of the Telegraph*, for May, 1877, leaving it to our readers to draw their own conclusions: "There is another claimant in the field for the honor of inventing the telephone. Dr. James Davis, of Salisbury, N. C., writes to the Raleigh *Observer*, stating that his 'phonetic telegraph,' invented ten years ago, anticipated the discoveries of Messrs. Bell, Gray, and others. Dr. Davis says that he made pen-and-ink drawings at that time, fully illustrating his invention, and that he described his apparatus to persons whom he names. He declares that his device covered the changing of air vibrations into those of electricity, and restoring the air waves after transmission; that his apparatus was more perfect than that which the present inventors exhibit, and that it could write or register the sounds in a distinct language."

Our last quotation is from a source where one would least expect to find it, viz., in the post-prandial oration of a Minister Plenipotentiary! At a grand banquet given to Professor Morse in December, 1868, Sir Edward Thornton, then our Minister at Washington, said, in the course of his response to the toast of his Sovereign, "Should I have the good fortune to live to the age of the venerable professor, I hope to see some such improvements as will enable us to carry on *vivâ voce* conversation by means of the cable. We shall then have merchants on this side of the water, discussing their affairs with those of the other at so much a minute. We shall hear, perchance, of some love-stricken youth of London or Paris whispering soft nothings along the cable to one of those bewitching syrens of New York at so much an hour, she tempting him all the while to throw himself into the gulf which separates them. We shall have statesmen, aye, and in those days of progress, even stateswomen, discussing international questions at so much a conference, and we poor diplomatists shall run a very good chance of being exploded altogether."

Considering the occasion, many people would, perhaps, pass by these sentiments with a sneer, characterizing them as mere fantastic conceptions, as ideas that are not more than a dream, if, indeed, they would limit themselves to expressions so mild; but we, having the sad fate of the Comte du Moncel before our eyes, and being still on the right side of forty, hesitate to adopt this course. The British Minister, of course, spoke in jest, but we, seeing that more unlikely things have come to pass, may echo his sentiments in earnest.

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[*] See the *Journal* of the East German Telegraph Company of that date, or the reprint of the paper, in 1863, in Dingler's *Polytechnisches Journal*, vol. clxix. p. 20.

[†] See No. 15 of Böttger's *Polytechnisches Notizblatt*.

THE ELECTRICAL ACCUMULATOR COMPANY.

THE following extract from the report of the proceedings at the general meeting of shareholders of the Electrical Power Storage Company, of London, is of interest, as throwing considerable light upon the affairs of the Electrical Accumulator Company, recently organized here, and of the Light and Force Company, organized some time since under the Faure patents.

The Chairman said: "This is really the first occasion on which the directors of the company have had the pleasure of meeting the shareholders, after an interval sufficient to give evidence of the prospects of the company. These, I am sure you will agree with me, when you have heard the plain statement I propose to give you, are of an assuring character. As you are aware, the company was formed in March, 1882, with an issued capital of £400,000, of which £300,000 in fully paid-up shares was for the purchase of the Swan, Sellon & Volckmar patents. The remaining £100,000 was subscribed privately by a few investors, myself among the number, who had great faith in the commercial future of a fairly practical accumulator, such as we were then, and are now, confident the Sellon-Volckmar accumulator is. We were advised by eminent authority that our patents were independent of the Faure patent, but at the same time it was within our knowledge that had we the full possession of certain portions comprised in the principle of the Faure patent, our accumulator, effective as it then was, might still be rendered more economical in a manufacturing point of view; in other words that, as regards a portion of the process of our manufacture, if we held the Faure patents they would be of great value to us on account of the money saving we could effect. We, therefore, were willing to make an arrangement with the holders of the Faure patents, and after a negotiation an arrangement was come to by which we secured the Faure patents for the world, except as regards the United Kingdom, where certain privileges were reserved to the Faure Electrical Accumulator Company. Subsequently, further negotiations took place, and we obtained for our company the sole, unconditional and undivided rights to the whole of the Faure patents for the world. This purchase was effected without a shilling of cash being paid in, the consideration being £200,000 in fully paid shares. I must explain, however, that at the time of the original negotiations with the owners of the Faure patents, they were under certain engagements as to the sale of their American and Belgian rights. Under these circumstances we were obliged to adopt these engagements without any benefits attaching to them. What we shall do in future with the Belgian company I cannot at present say. The other engagement was of quite a different character, greater in magnitude, and capable of giving immense returns to this company. The contract, as regards the American patents, was with a company called the Force and Light Company of New York, formed with a capital of $5,000,000. The arrangement was that the Faure patentees should be entitled to this stock, less $100,000, and should receive the proceeds of the sale of this stock when the American parent company had apportioned out its rights in the different States and districts of America. The Force and Light Company of New York was not formed by us in any way, and as we wished to enter into possession of our stock, we thought it expedient to send over to New York, one of our number, Mr. Courtenay, accompanied by a member of the firm of the company's solicitors. Mr. Courtenay found it necessary to institute proceedings against the trustees of the New York company, who have apparently been desirous to secure to themselves, as much as possible, the benefit which rightly belongs to us. These proceedings, they advise us, can only have one result—namely, in our favor; but in the meantime, as the Force and Light Company of New York were not possessors of the Sellon-Volckmar patent, and that was the really valuable one, our representatives secured the co-operation of some leading gentlemen in America, and a company with a capital of $5,000,000, called the Electrical Accumulator Company was formed, which takes over the Sellon-Volckmar patent for $2,600,000; the balance of $2,400,000 being reserved for working capital, and for the purchase of our interest in the Force and Light Company of New York, when that stock is handed over to us. The amount we have had to expend and deposit, consequent on the negotiations and proceedings as to the American interests, is £2,333. 9s. 6d., which we propose to carry over until the settlement of affairs in America."

It is extremely refreshing to observe the confident reliance which is placed upon the immense returns to be expected from apportioning out rights in the different States and districts of America, and the immensely inflated basis on which the stock operations are to be conducted to that end.

So far as these proceedings throw any light upon the affairs of the original Faure Company, it appears that only $100,000 of the entire capital stock of $5,000,000 was to be devoted to working capital, and payment for the services of the promoters. Of the $5,000,000 of the Accumulator Company, which, as we understand, has finally effected a settlement with the original Faure Company, $2,600,000 is to go to the English company directly. Of the remaining $2,400,000 of stock, it does not appear how much is to be used for working capital, and how much for taking up the rights of the original Faure Company. In any view of the case, the allotment of cyphers to the capital stock is apparently very liberal. Whether the American public will contribute the requisite number of dollars for the significant figures, remains to be seen.

ELECTRIC ACCUMULATORS.

THE *Revue Industrielle* thus resumes the question of accumulators: "When the accumulators first appeared, two years ago, one of their first applications, as intended by their inventor, was the traction of cars and wagons. Some experiments were made, but their success did not fulfill the hopes entertained, and better days had to be waited for. The amalgamation into a single English company of the interests of the Faure, Sellon and Volckmar accumulators, has been followed by renewed attention to these accumulators, and, outside of the doubtful advantage of their application to electric lighting, it was thought that the question of tramway traction could be favorably solved by their use. Messrs. Ayrton and Perry did a great deal to drag the company into a path that has been found full of difficulties from the outset.

"A number of *savants* and electricians recently accepted the invitation of the Electrical Storage Company, to witness the inauguration, at Gunnersbury, of an electric tramway on the lines of the West Middlesex. The car itself did not present any novelty, except the absence of the yoking parts. The motive power was furnished by fifty accumulators of the Faure-Sellon-Volckmar system, which were stowed away under the seats, and which worked a Siemens' dynamo-electric machine, type D. It is unnecessary to go into the details of the transmission of power to the wheels. A speed of from six to eight miles per hour was thought to have been obtained.

"The car was readily stopped by the interruption of the current, and the use of the ordinary brake. The speed may be varied by using a commutator, which introduces more or fewer elements in the circuit. The change of direction is easily obtained, by an ingenious arrangement of brushes, the invention of Siemens Brothers. There are two pair of brushes, one for the forward movement, and the other for backing, and these are placed on two levers, which are elbowed in the following way: When both levers are vertical, none of the brushes touches the commutator; when they are inclined, by means of a switch—to the right, for instance—the upper brush of the left lever, and the lower brush of the right lever, rub on the commutator, and the forward motion is produced. When they are inclined to the left, the upper brush of the right lever, and the lower brush of the left lever, come in contact in their turn, and the car is backed; the diameter of the contact of the commutator has undergone an angular displacement of from 70° to 80°.

"The fifty accumulators weigh some 1,800 kilos (1¼ tons), and occupy a space of 812 cubic decimetres; their dimensions are 325 x 275 x 175 millimetres, and their weight about 98 pounds. The storage capacity for the whole is some 560 ampére hours, with an electro-motive power of 107 volts; under ordinary circumstances, about 70 per cent. of this can be utilized. The electro-dynamo machine is calculated to work with a power of 100 volts, and a current of 60 ampéres, which corresponds to 6,000 volt-ampéres, or about 8 horses. Under the direction of General Hutchinson, several trips were made, and a maximum of 6 miles obtained. The use of leather belts showed, however, a want of ingenuity, and the mechanism was insufficient to give the starting power. Mr. Sellon maintains that the cost is only 6s. 3d. per diem for the electric power, while it is 26s. for horse. However, future trials will prove whether the Faure-Sellon-Volckmar apparatus is practicably available, or only fit for collections of natural philosophy instruments."

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ELECTRIC LIGHT COMPANIES.

THE wide-spread interest in new applications of electricity, and the great expectations in regard to the results which are to be accomplished by them, are shown in a striking manner, by the rapid increase in the number of companies organized for working electrical inventions.

While the remarkable developments of the past few years have afforded large opportunities for the legitimate investment of capital, various causes have contributed to give prominence to the speculative side of the movement.

The application of electricity to the useful arts has, for a long time, been a peculiarly fascinating subject, and the great progress recently made in electrical science, has stimulated popular interest, and attracted public attention to a very unusual degree. With strong popular interest has been combined great popular ignorance. The subject is, in its commercial application, a new one, and very few have sufficient technical knowledge to understand even its elementary principles. Unscrupulous adventurers and visionary inventors have taken advantage of this state of affairs to bring before the public a great number of enterprises of little merit—many of them purely speculative—and in some cases have succeeded in enlisting a considerable amount of capital.

The great commercial success of some of the leading companies, and the large anticipations which are generally entertained in regard to the future of the business, have also encouraged the formation of new companies.

While the practical results already accomplished in electric lighting are almost unexampled in industrial history, it is generally believed, and we think with reason, that these results are altogether insignificant in comparison with what is to be realized in the near future in this and kindred applications of electricity.

For lighting by isolated plants, both the arc and the incandescent systems are, no doubt, established upon a secure commercial basis. The same is true of the arc system for lighting from central stations. A large number of central stations for supplying arc lights have been established in different cities throughout the country, and many of these are, we believe, already earning a fair return upon the capital invested, with reasonable prospects of largely increasing their profits, with larger business, improved apparatus, and greater experience in management. The incandescent system, however, has not yet demonstrated its ability to compete with gas and other means of illumination, in a general system of distribution, and we believe its present limitations render such competition, for the time being, commercially impracticable, except in places where the superior quality of the light commands a higher price than is paid for gas. These limitations, however, do not appear to be insuperable in their nature, and improvements in lamps, or in the system of distribution, will undoubtedly be devised, which will render the incandescent system available for general use.

Transmission of power by electricity is a field entirely untouched, commercially, and it will probably prove a larger field, and much more profitable to work than electric lighting. Other highly profitable applications of electricity will undoubtedly be developed by the perfection of apparatus for generating and distributing large currents economically, and all these follow directly in line with the work which the electric light companies are now doing.

The hope of sharing in the immense profits, which must result from a diligent cultivation of the field thus opened, has been a strong inducement for the investment of capital in new companies; and this has been greatly promoted by the extreme facility afforded by the laws of most of the States for the creation of corporations involving no personal liability of stockholders, and the almost entire freedom of the business of such corporations from supervision, restraint, or publicity. Very many who could not be induced to assume any personal responsibility in regard to a new enterprise, without thorough investigation, readily invest a limited amount in it upon the most cursory examination, when their liability does not extend beyond the amount invested.

Some idea of the extent and character of this movement may be obtained from the list of electrical companies, chiefly electric light companies, which we publish on pages 134 and 135. This list has been compiled from the official records of the State of New York, and from such general information as we have been able to obtain in regard to two or three of the principal companies doing business here, which were organized in other States. As nearly all the States in the Union have general laws, under which corporations may be organized, and as the mania for speculation has been even more prevalent in some of the other States, than in New York, the list which we give, probably comprises only a very small part of the companies actually organized in the United States. The data obtainable from official records are extremely meagre, and do not generally comprise even the amount of cash capital paid in; so that the information we are able to give, even in regard to these is only of the most general character.

While it is not our purpose to attempt to give the history, or present condition, of the different companies, some general consideration of the relation of the companies to each other, and to the future development of the business, may not be entirely amiss.

Some time since, seven of the principal companies formed an association under the name of the Gramme Electrical Company, the principal object of which was understood to be the enforcement of the Gramme patent, and the patents of the associated companies, against all outside of the organization. Although this object does not appear to have been pursued as yet in a very vigorous manner, the Gramme Company still forms the basis of an extremely powerful combination, which cannot well be disregarded.

It will be observed, that nearly all of the Gramme companies were organized at a comparatively early date, and all of them, with the exception of the Jablochkoff company, appear to have taken a much larger share in the legitimate development of the business, than any of the companies outside of the organization. We think it would be within bounds to say, that nineteen-twentieths of all the legitimate commercial business done in this country has been done by the Gramme companies. Of these, the Brush Company, the United States Company, and the Edison Company, appear to have secured a much larger share of the business, than any of the others, and the two former are the only members of the association, so far as we can ascertain, which have as yet paid dividends.

The Brush, the Fuller, and the American Companies are working arc systems; the Edison Company devotes its attention, exclusively, to the incandescent system, the United States Company is introducing both systems. The business of these companies consists mainly in the manufacture and sale of apparatus, both to private users and to subsidiary organizations, formed for furnishing lights from central stations, and in the disposal of rights under their patents, to local organizations. The position of the Edison Company, however, is somewhat peculiar, as it does not appear to conduct any manufacturing business directly; the dynamo machines, lamps, fixtures, and other apparatus of the Edison system being manufactured by separate organizations, the details of which we have not been able to ascertain. The position of the Brush Company in regard to patents, is also somewhat different from that of the others, in that it does not own the Brush patents, but holds an exclusive license under them from Mr. Brush, at a royalty of twenty per cent. upon its receipts from the sale of apparatus.

We have not been able to ascertain definitely, the amount of cash capital invested in the different Gramme companies. The Brush Company was the outgrowth of the Telegraph Supply Company of Cleveland, which was organized in 1875, with a capital of $100,000, for the purpose of manufacturing telegraphic instruments, and other electrical apparatus. Some time in 1877, this company took up the manufacture of the Brush apparatus, in connection with its other business, and in 1880 the name of the company was changed to its present form. In 1881, the capital of the company was increased to its present amount of $3,000,000. How much of the original capital stock, or of the increased capital stock was issued for cash, we have not been able to ascertain, but it is generally believed that the increased stock was not all issued for cash.

The United States Company was originally organized with a capital of $250,000, which has been increased from time to time to its present amount of $1,500,000. Of this it appears, from the annual report filed by the company, that $970,000 was issued for cash, and $530,000 for patents and other property.

The Weston Company has been practically absorbed by the United States Company. Of the capital stock of this company $140,000 appears to have been issued for cash, and $60,000 for patents.

The annual report of the Fuller Company shows that $205,900 of its stock has been issued for cash, and $664,100 for patents and property.

The Edison Company was originally organized with a capital of $300,000, which has been increased from time to time to its present amount of $720,000. The annual report of this company shows that, of this, $312,891 has been issued for cash, and $300,400 for patents and other property.

Of the capital stock of the American Company $98,750 appears to have been issued for cash, and the remaining $26,250 has, we suppose, been issued for patents or other property. This company has its principal place of business at New Britain, Conn., and should not be confounded with the American Electric Light Company of New York, with which, we are informed, it has no connection.

Of the capital stock of the Jablochkoff Company, $41,600 appears to have been issued for cash, and $2,200,000 for patents and other property.

Probably the amount of cash capital directly invested in all of the Gramme companies, may be safely estimated at from three to four million dollars.

Of the ninety-two companies embraced in the main part of the list, four appear to have been organized for working or disposing of the Edison foreign patents, and nine are subsidiary or local organizations of the different Gramme companies, formed chiefly for furnishing lights from central stations. Most of the latter companies have invested considerable amounts of capital in erecting stations and procuring plant, and some of them are already doing a large and apparently profitable business. The aggregate investment of the three local companies, which are now operating stations in this city, is, as nearly as we can ascertain the facts, between two and three million dollars. A large number of similar companies have been organized by the Gramme companies in other States, and the total amount of capital actually invested in them must be very considerable. We have no means of ascertaining this amount with any degree of precision, but should say, that the Gramme companies and their subsidiary organizations, must represent a cash investment of at least ten million dollars, and probably much more.

Of the remaining seventy-nine companies, we have not been able to discover that more than three or four have any apparatus in actual commercial use. Perhaps ten or a dozen others have done more or less experimental work, and are making some effort to get their apparatus into proper form for practical use. Many of the others have died a natural death, and many of them appear to have been organized for purposes of speculation, pure and simple. It has evidently been the aim of the founders of these latter concerns to meet the unlimited demand for stock, which they believed to exist, rather than to undertake the more expensive and less profitable task of supplying the public with efficient apparatus. Judging from the enormous aggregate capitalization shown by our list, it would seem that sufficient provision has already been made for absorbing the surplus cash of even the most credulous possessor of capital.

The total nominal capital of the companies embraced in our list, is $122,445,000; deducting from this the $3,325,000 capital stock of the three Gramme companies, which were not organized in New York, we have $119,120,000 as the capitalization of the companies organized in a single State. The population of New York is, in round numbers, about one-tenth that of the Union, and if we assume that companies have been formed in the other States at about the same rate, in proportion to their population, as in New York (an assumption which we think would not be far out of the way), we should have about $1,200,000,000 as representing the nominal capitalization of the electric light, electric power and storage battery companies organized in the United States. Even these figures do not appear to mark the limits of the movement, as new companies are coming into existence more rapidly than ever before.

We have no means of estimating, even approximately, the amount of capital actually invested in the business by the companies which are embraced in our list, outside of the Gramme organization, but we believe it to be comparatively small. Deducting from the total capital stock of all the companies $15,065,000, the stock of the Gramme companies and their subsidiary organizations, we have $106,380,000 as the capitalization of the other companies. We doubt if all these latter companies, together, have invested $500,000 in actual development and prosecution of the business. So far as the official records disclose the amount of cash capital paid in to the companies of this group, they show it to be very small. The greater part of these companies have filed no annual report, many of them not yet having been in existence for a year, and many of those of earlier incorporation having been practically abandoned. The following are the figures in regard to payment of capital given by some of the reports which have been filed.

GRAMME COMPANIES.

NAME OF COMPANY.	*Date of Incorporation.*	*Capital Stock.*	*Nominal par value per share.*	*System.*
The Brush Electric Co	Oct. 18th, 1875	3,000,000	100	Brush.
The Weston Electric Light Co	July 7th, 1877	200,000	100	Weston.
The United States Electric Lighting Co	June 8th, 1878	1,500,000	100	Weston and Maxim.
The Fuller Electrical Co	Oct. 2d, 1878	870,000	100	Fuller and Wood.
The Edison Electric Light Co	Oct. 17th, 1878	720,000	100	Edison.
The American Electric Co	July 16th, 1880	125,000	25	Thomson-Houston.
The Jablochkoff Electric Lighting Co	Jan. 27th, 1881	2,250,000	100	Jablochkoff.
	Total	$8,665,000		

OTHER COMPANIES INCORPORATED IN THE STATE OF NEW YORK,
INCLUDING GRAMME SUB-COMPANIES.

NAME OF COMPANY.	*Date of Incorporation.*	*Capital Stock.*	*Nominal par value per share.*	*System.*
The U. S. Electric Engine Co	Oct. 24th, 1877	1,000,000	100	Sawyer.
The Hussey Electro Magnetic Engine Co	June 21st, 1878	100,000	100	Hussey.
The New York Electric Light Co	Nov. 11th, "	5,000,000	100	
The National Electric Light and Power Co	Nov. 20th, "	300,000	100	Heikel
The Brooklyn Electric Light Co	Dec. 16th, "	2,500,000	100	
The Dynamo Electric Co	Jan. 4th, 1879	500,000	100	
The International Electrical Co	Jan. 10th, "	24,000	100	
The Manhattan Electric Light Co	Jan. 18th, "	3,000,000	10	
The Hussey Electro Magnetic Motor Co	July 15th, "	300,000	50	Hussey.
The American Dynamo Electric Machine Co	Oct. 27th, "	5,000	50	Levett-Muller.
The Metropolitan Electric Light Co	Feb. 17th, 1880	200,000	40	
The Rochester Electric Light Co	Feb. 23d, "	100,000	20	Weston and Maxim.
The Universal Electric Light Co	April 8th, "	10,000,000	100	Beardslee.
The Arnoux-Hochhausen Electric Co	Sept. 3d, "	100,000	100	Arnoux-Hochhausen.
The New Electric Light Co	Sept. 8th, "	100,000	100	Lugo.
The Brush Electric Light Co., of New York	Sept. 10th, "	100,000	100	Brush
The Lugo Dynamo Electric Co	Oct. 2d, "	100,000	100	Lugo.
The Dynamo Electric Power and Light Co	Oct. 13th, "	5,000,000	100	
The Edison Illuminating Co	Dec. 17th, "	1,000,000	100	Edison.
The Manhattan Electric Light Co	Dec. 20th, "	600,000	100	
The Franklin Electric Light Co	Dec. 23d, "	600,000	100	
The Edison E. L. Co. of Europe, Limited	Dec. 24th, "	2,000,000	100	Edison.
The N. Y. Electric Light Association	Dec. 27th, "	300,000	100	Daft.
The United States Illuminating Co	Jan. 31st, 1881	1,000,000	100	Weston and Maxim.
The Blanchard Electric Light and Power Co	Jan. 11th, "	1,000,000	10	Blanchard.
The Higgs Electric Light and Power Co	Jan. 11th, "	500,000	5	Higgs.
The Nassau Electric Light Co	Feb. 1st, "	250,000	100	
The Standard Electric Light Co	Feb. 18th, "	250,000	100	Holcombe.
The Brush Electric Illuminating Co	Feb. 19th, "	1,000,000	100	Brush.
The American Electric Light Co	April 4th, "	500,000	50	Bohm, Fox and Bernstein.
The Albany Electric Illuminating Co	April 7th, "	100,000	100	Brush.
The American Electric Light Co	April 12th "	400,000	20	Markland.
The Saratoga Electric Illuminating Co	May 2d, "	50,000	100	
The Edison Electric Light Co. of Havana	June 17th, "	1,000,000	100	Edison.
The Edison Electric Light Co. of Porto Rico	June 17th, "	1,000,000	100	Edison.
The Electric Motive Power Co	June 25th, "	500,000	100	
The Manhattan Electric Power Co	June 27th, "	100,000	100	

NAME OF COMPANY.	Date of Incorporation.	Capital Stock.	Nominal par value per share.	System.
The Brush Electric Light Co., of Rochester	June 25th, 1881.	100,000	100	Brush.
The Excelsior Electric Co	Aug. 2d, "	500,000	100	Hochhausen.
The Central N Y Electric Light and Power Co	Aug. 24th, "	50,000	100	Daft.
The Markland Electric Light and Power Co	Sept. 13th, "	600,000	1	Markland.
The Levet-Muller Electric Light Co	Oct. 2d, "	1,000,000	100	Hans J. Muller.
The United Globe Electric Light Co	Oct. 7th, "	6,000,000	100	
The Mutual Electric Light and Supply Co	Oct. 24th, "	500,000	25	Charles E. Long.
The American Electric Railway and Power Co	Oct. 24th, "	10,000,000	25	
The National Electric Light Co	Oct. 28th, "	1,000	10	
The Edison Co., for Isolated Lighting	Nov. 23d, "	1,000,000	100	Edison.
The Crescent Electric Light and Motor Power Co	Dec. 8th, "	500,000	10	Holcombe.
The International Electric Co	Dec. 13th, "	500,000	100	
The Edison Spanish Colonial Co	Jan. 12th, 1882	100,000	100	Edison.
The Union Electric Light and Power Co	Jan. 16th, "	2,500,000	50	Keith.
The Sheridan Electric Light Co., of N. Y	Jan. 23d, "	500,000	50	Sheridan.
The Metropolitan Electric Light and Power Co., of the United States	Jan. 25th, "	150,000	10	F. H. Beers.
The Metropolitan E. L. and Power Co. of Columbia Co., N. Y. State	Feb. "	30,000	25	F. H. Beers.
The Daft Electric Light Co	March 3d, "	500,000	100	Daft.
The Hathaway Electric Light and Power Co	March "	10,000,000	100	
The Metropolitan Electric Light and Power Co , of the State of N. Y.	March 9th, "	300,000	10	F. H. Beers.
The Swan Incandescent Electric Light Co	March 17th, "	800,000	100	Swan.
The Swan Incandescent Electric Light Co., for the Pacific Coast	April 24th, "	500,000	100	Swan.
The Light and Force Co	May 20th, "	5,000,000	100	Faure.
The Brush-Swan Electric Light Co	May 24th, "	2,000,000	100	Brush-Swan.
The Electrical Storage and Power Co	June 5th, "	100,000	100	Buel.
The New York and Chicago Electric Underground Co	June 22nd, "	2,500,000	5	
The Vanderweyde Electric Co	July 14th, "	20,000	100	Vanderweyde.
The Fitch Electric Light and Construction Co	July 28th, "	100,000	100	
The Parker Electric M'f'g Co	Aug. 2nd, "	40,000	100	Parker.
The Metropolitan E. L. and Power Co , of the city of Binghampton	Aug. 5th, "	75,000	10	F. H. Beers.
The Binghampton Magneto Electric Light and Power Co	Aug. 9th, "	50,000	10	
The Central American Electric Light Co	Aug. 9th, "	300,000	100	Bohm, Fox & Bernstein.
The New England Electric Storage Co	Aug. 10th, "	2,000,000	100	Faure.
The National Underground Electric Co	Aug. 15th, "	2,500,000	100	
The Ball Electric M'f'g Co	Aug. 16th, "	500,000	100	Charles E. Ball.
The Slattery Incandescent Lamp Co	Sept. 2nd, "	200,000	100	Slattery.
The Keith Electric Co	Sept. 6th, "	800,000	100	Keith.
The Consolidated Electric Light Co	Sept. 8th, "	1,200,000	100	Sawyer, Man & Knowles.
The Western States Electric Storage Co	Oct. 7th, "	2,000,000	100	Faure.
The Star Electric Light and Power Co. of the U. S.	Oct. 9th, "	300,000	10	
The Long Island Electric Light and Power Co	Oct. 19th, "	500,000	10	Hussey.
The Southern States Electric Storage Co.	Oct. 21st, "	2,000,000	100	Faure.
The Olmsted Electric Light and Power Co	Nov. 2nd, "	1,000,000	100	Olmsted.
The Faure Electric Storage and Light Co	Nov. 15th, "	2,000,000	100	Faure.
The Metropolitan Electric Light and Power Co., of the city of Brooklyn	Nov. 17th, "	1,000,000	10	F. H. Beers.
The Schuyler Electric Light Co	Nov. 17th, "	1,000,000	100	Schuyler.
The Marine Electric Light and Storage Co	Nov. 23rd, "	2,000,000	100	Faure.
The Empire State Electric Light Co	Dec. 1st, "	100,000	25	
The Hussey Electric Light and Power Co	Dec. 7th, "	1,000,000	10	Hussey.
The Phœnix Electrical Co., for N. Y	Dec. 8th, "	350,000	100	
The Phœnix Electrical Co., for Canada	Dec. 8th, "	350,000	100	
The New York and Brooklyn Electric Light Co	Dec. 30th, "	25,000	10	
The Standard Electric M'f'g Co	Jan. 25th, 1883.	60,000	100	
The Electrical Accumulator Co	Feb. 21st, "	5,000,000	100	Sellon-Volckmar.
The Schuyler Foreign Electric Light Co	March, 6th, "	1,000,000	100	Schuyler.
	Total.......	$113,780,000		

Grand Total, { Gramme Companies.......................... $8,665,000
Other Companies.......................... 113,780,000
$122,445,000

	Issued for Property.	*Issued for Cash.*
The Arnoux-Hochhausen Electric Co. ...	$ 100,000.	
" Lugo Dynamo Electric Co........	99 600.	$ 400.
" New York Electric Light Association.	300,000.	
" Blanchard " " & Power Co.	1,000,000.	
" Excelsior Electric Co	482,500.	16,750.
" Markland " Light & Power Co.	600,000.	
" Sheridan Electric Light Co	500,000.	
" Fitch " "	100,000.	
Total............................	$3,182,100.	$17,150.

It will probably be safe to assume that the "property" for which the stock is issued, consists, in nearly all cases, of patents. If the proportion of cash to patents should continue the same.through the rest of the list, the amount of cash actually paid in to all the companies of this group would be a little more than the amount we have indicated. Undoubtedly, this does not by any means represent the extent of the contribution levied upon the investing public by these enterprises. The stock having been issued to promoters for the patents, has been sold by them to the public at large for such prices as could be obtained. How much has been realized by the promoters of these companies, in this way, no man can tell, but the aggregate amount must be very large.

While the greater part of the companies, recently organized, have been devoting their attention principally to experiments, and to speculation, the principal companies, which entered the field at an earlier date, have been steadily strengthening their commercial position.

As we have already said, the legitimate business already done, has been done almost entirely by the Gramme companies, and all indications seem to point to a further concentration of the business in their hands, rather than a distribution, of any considerable part of it, among additional competitors.

It appears, from a circular recently issued by the Gramme company, that the associated companies own, or control, between four and five hundred patents, relating to electric light and power. This large number of patents, if used together, and backed by the great commercial weight of the companies owning them, would prove an extremely formidable obstacle to the success of any outside competitor.

Considerable misapprehension appears to exist in regard to the relation of patents, to the future development of the business. As the fundamental principles of dynamo machines, arc lamps, incandescent lamps, and other necessary parts of the apparatus, have long since become public property, it is by many hastily assumed, that existing patents cover only immaterial variations, which are not essential. This is an entirely mistaken view. Existing patents, in fact, cover a great mass of improvements, some of them important in their nature, many of them relating only to details, but together, representing the difference between the crude and imperfect apparatus of some years since, and the complete and efficient systems which some of the leading companies are now introducing. It is quite easy to make operative apparatus without infringing any patent, but it is extremely difficult, if not altogether impossible, for any person, except those who entered the field at an early date, to make apparatus which is capable of competing in the market, without infringing a good many patents.

The difficulty of avoiding existing patents has been materially increased by the policy, which the principal companies have adopted, of not selling detached parts of apparatus, so that any competitor has to be prepared to furnish a complete system, in order to do any business at all.

To work out all the practical details of an efficient system in the face of these difficulties, and to provide the necessary manufacturing facilities for placing any company upon a really commercial basis, would require an amount of courage, inventive ability, and capital, which few, if any, of the organizations, outside of the Gramme companies, can bring to bear upon the subject.

Some comfort and encouragement for the outside companies may be had from the present lack of harmony among the associated companies, in regard to patents, but the continuance of this state of affairs can hardly be relied upon. The field is large enough for the five or six companies that are now doing the business, and a combination of patents is so plainly for their advantage, that they will. no doubt, find some way to settle their differences with each other, whenever the competition of outside companies becomes at all serious.

Under these circumstances, the outlook for new companies does not seem very encouraging, and capitalists will do well to make very careful investigation, before investing much money in them.

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

II.—PRINCIPLES OF ECONOMY; SPECIAL REQUIREMENTS.

THE principles of economical working, noted by James Watt, and plainly stated by him, were but slowly recognized by others, and the improvement of the steam engine was. for many years, correspondingly slow. The principles that must govern the engineer, in the attempt to secure highest efficiency, may be summarized thus:

1. The greatest practicable range of commercially economical expansive working of steam must be adopted; the fluid must enter the cylinder at the highest admissible pressure, and must be expanded down to the minimum economical pressure at exhaust.

2. The wastes of heat must be made the least possible; all loss of heat by conduction and radiation from the engine must be prevented, if possible, and the usually much more serious waste which occurs within the engine, by transfer of heat from the steam side to the exhaust, by "cylinder condensation" and re-evaporation, without doing its proportion of work, must be checked as completely as is practicable. This latter condition, as well as commercial considerations, limits the degree of expansion allowable. It also dictates high speed of engine.

3. The largest amount of work must be done by the engine that it can perform, with due regard to the preceding conditions. This condition compels us to drive the engine up to the highest safe speed, and to adopt the highest practicable mean steam pressure.

The first two of the above requirements give maximum efficiency of fluid, consistent with commercial economy, and the latter gives highest efficiency of machine. In addition to these requisites, which are not peculiar to any style of engine, or to any one of the innumerable applications of steam power, the adaptation of the machine to driving the dynamo-electric apparatus of an electric lighting plant, compels the designing and constructing engineer to meet certain demands which, although not peculiar to this work, are, nevertheless, more imperative here than elsewhere. The principal of these requirements are effective regulation, compactness, simplicity of parts, strength and durability, and small cost, both of original purchase and of repairs. In the attempt to meet these demands, the modern "high speed engine" has gradually taken shape.

In the time of Watt, a pressure of seven pounds of steam, with condensation, and a low piston speed, equal, usually, in feet per minute to about one hundred and twenty-eight times the cube root of the length of stroke, according to Watt's own rule, represented standard practice. As time went on, steam pressures and piston speeds gradually rose, and when, in 1849, Corliss brought out the typical modern "*Drop Cut-off Engine*," pressures of sixty pounds, and speeds of piston reaching 450 feet per minute were becoming usual. At such speeds, the "drop cut-off" was thoroughly effective, and the steam valve, detached from the driving mechanism, fell into its seat with sufficient promptness and accuracy, as to time of closing, to do good work; the governor had no other work to do than to detach the valve, and was thus able to regulate with an exactness that is still beyond competition. These engines are very extensively used to drive the smaller electric light machines, and particularly where a considerable number are to be driven together; they are not adapted to the work of driving the large "dynamo," where it is desired to couple direct from crank-shaft to armature.

As piston speeds increased, the drop cut-off became less satisfactory, where the load was variable. It became slowly understood, among builders and users of engines, that one important element of economy of fuel and cheapness in cost of engine is the maximum speed of engine consistent with endurance and safety. Speeds were, after a time, rapidly increased, the Porter-Allen engine leading in this movement, and small engines, working at high speed, displaced large engines of the older type. It soon became evident that this change must lead to the re-introduction of the "positive motion" classes of valve gear and expansion gear that Sickles, Corliss and Green had temporarily displaced, notwithstanding the fact that these builders had greatly increased the speeds of their engines. All the so-called "high-speed engines," which are best known in the market, are of this later type. The slower running engines are nearly all fitted with governors of the fly-ball class, geared, or belted, to revolve at a much higher speed than the engine itself; but the great velocity of rotation of the new engines, from 200 to 500 revolutions per minute, in the small sizes, and often a piston speed of about 800 times the cube root of stroke, permits the attachment of the governor directly to the shaft; and this is done in the later styles. This change of position of the governor, in turn, has led to a change in its construction. The balls, instead of being hung from a vertical revolving spindle by arms pivoted on that spindle, are attached to arms carried on the main shaft, or the driving pulley, and revolve in a vertical plane at right angles to the shaft; they are held in place against the action of centrifugal force by springs, and arranged to adjust the eccentric, and to vary the expansion, in a manner which will be plainly seen when studying their construction in the later issue of THE ELECTRICIAN, in which these engines will be described with the aid of carefully made engravings. The high speed engine, as adapted to the work of directly driving the "dynamo," therefore, may be described as a high pressure, non-condensing engine, of short stroke, and high speed of rotation, with a positive-motion valve-gear, and regulated by a governor, which is usually mounted on the shaft, and so attached as to alter the expansion by varying the lead of the valve. Its essential features are high speed of rotation, good regulation by a positive gear, economy, simplicity, and compactness. It is this engine only, which is found to do good work under these peculiarly exacting conditions.

It is proposed to study the best known engines of this and the earlier classes, and to compare them, with a view to bringing out their peculiarities and their special merits, while the purchaser will, besides, study the machine which he proposes to buy, to determine whether its material and workmanship are as excellent as are the principles of its design.

The conditions demanded can here be merely outlined, in the following resumé[1] of the requisites of successful practice:

1. A good design, by which is meant:
   a. Correct proportions, both in general dimensions and arrangements of parts, and proper forms and sizes of details to withstand safely the forces which may be expected to come upon them.
   b. A general plan which embodies the recognized practice of good engineering.
   c. Adaptation to the specific work to be performed, in size and in efficiency. It sometimes happens that good practice dictates the use of a comparatively un-economical design.
2. Good construction, by which is meant:
   a. The use of good material.
   b. Accurate workmanship.
   c. Skillful fitting and a proper "assemblage" of parts.
3. Proper connection with its work, that it may do that work under the conditions assumed in its design.
4. Skillful management.

In the endeavor to secure these requisites, it is generally advisable to use steam at a pressure not far from one hundred pounds per square inch. The benefits of increasing pressure diminish so rapidly above this point, that it is not yet certain whether it will, with existing engines, pay to carry pressure much higher. The ratio of expansion is to be determined with reference to this pressure, as well as to size of engine. It will usually be found even more wasteful to cut-off too short than to "follow" too far; and Rankine's principle of adjusting this point by consideration of the relative cost of large and small engines, as well as the principles controlling the economy of fuel, dictate, that for these engines, which are nearly always non-condensing and unjacketed, the ratio of expansion must usually be low—say from three to five, as higher pressures range from sixty to one hundred pounds per square inch[2]—and that the terminal pressure shall usually be kept about five or ten pounds above that of the atmosphere.

Moderate "superheating" is found advantageous; but it is seldom carried beyond about a hundred degrees above the normal temperature of the steam. "Steam jacketing," as practiced in nearly all compound engines, is of advantage; but is not usually considered to pay for the added cost and risk in engines of the class here considered, and especially in high-speed engines. The "compound" engine has not found a place in this field. Smeaton's idea—or rather Watt's, first attempted on a large scale by Smeaton—of surrounding the working fluid with non-conducting surfaces, is not yet found practicable with the high steam pressures and temperatures now usual. Its final adoption, however, is beyond doubt, as it is a far more promising system of economizing heat, now wasted, than either superheating or steam jacketing. The latter, indeed, is a method of introducing a waste to check greater loss.

Careful protection of external heated surfaces of the cylinder against losses by conduction or radiation, is always practiced where it can be conveniently done, and parts which cannot well be so covered are highly polished. A well polished surface transmits very little heat.

Back pressure, a frequent cause of waste of power, is reduced by making the exhaust parts large, and the exhaust opening of the valve rapid, or else by giving "lead" to the exhaust, so that the steam shall leave the cylinder just before, rather than just after, the return stroke begins.

Friction is reduced to a minimum by carefully proportioning the journals, and by securing free and continuous lubrication with a good oil or grease.

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[1] U. S. Report on Machinery, etc., at Vienna, 1873. By R. H. Thurston.

[2] Report on Machinery and Manufactures. R. H. Thurston. Pp. 17, 18, 49; Vol. iii. Reports of the Scientific Commissioners of the United States to Vienna; 1873.

An engine in which all the above requirements are fully met is certain to be a good machine.

It is not proposed to compare the steam engine with the gas engine, or with other motors. The gas engine is, in many cases, likely to prove useful in consequence of its compactness, cheapness of first cost, freedom from risk, and small expense for attendance ; but it is expensive in use of fuel, and is rarely as little liable to annoying interruptions of operation as the steam engine, and also possesses other minor disadvantages. Nevertheless, Otto and Clerk, and other inventors and constructors, have greatly improved this machine of late, and have brought the expenditure, in ten-horse engines, down to twenty cubic feet of gas, or less, per hour and per horse-power ; and although this is still double the theoretical figure, no one can say how soon the latter consumption may not be much more closely approximated to. The gas engine is certain to find work in this direction. Hot air engines, as yet, give less promise ; but it would be rash to predict their total exclusion from the field.

Water-wheels, especially when used exclusively for supplying power to the lighting-plant, are, where available, thoroughly satisfactory prime movers.

In studying the steam engine from the standpoint here taken, we will divide them, first, with reference to their method of driving the dynamo-electric machine, into two classes:

1. Engines which may be used in driving by belt, and which are not adapted for direct connection.

2. Engines especially designed and constructed to be coupled directly to the "dynamo."

The first class of engines is in very extensive use, and is, by many of the more conservative engineers, still preferred to the second. The latter constitute the so-called "modern" type of engine, and are gradually coming into use, some engineers adopting them, both for direct and for indirect connection. The best engineers are not yet fully in accord in regard to the question, whether they have passed the experimental stage.

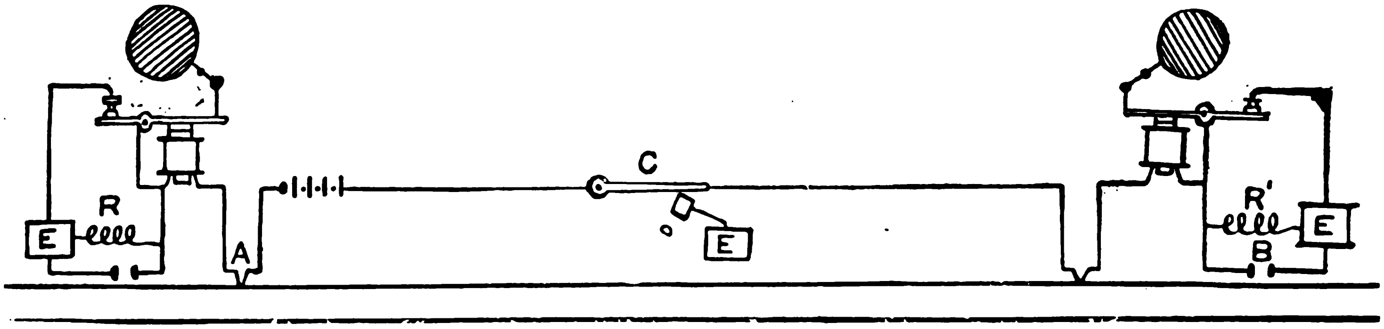
—— A SO-CALLED "ELECTRIC FLANNEL," has been invented, in France, by Dr. Claudat, who affirms that it is efficacious against rheumatism. This flannel contains, per kilogramme of wool, 115 grammes of oxides of tin, copper, zinc, and iron. A series of threads of the tissues, saturated with these metallic products, are woven alternately with the ordinary threads. The flannel so prepared forms a dry pile. M. Drincourt, professor of physics at the Rheims lyceum, and M. Portevin, of the polytechnic school, have proved, independently, by very precise experiments, that Dr. Claudat's flannel liberates electricity, either by simple contact, or (better) in contact with the products of transpiration when the tissue is applied to the body.

HADDEN'S AUTOMATIC RAILWAY SIGNAL SYSTEM.

During the past twenty years many attempts have been made, in this country and Europe, to provide electrical signal systems for railway operation, which should not only be correct in principle, but successful in actual practice. While great advances have been made in this direction, the various arrangements hitherto presented to railway managers have contained so many elements of weakness, that their general adoption has apparently been undesirable.

When the difficulties attendant upon the operation of an automatic system of signaling are considered, it will be seen that it is no easy problem to solve. The necessity for absolute perfection of operation, without constant supervision ; the tremendously rough nature of the power applied to the circuit changing instruments ; the difficulty of obtaining proper insulation of electrical contacts, together with the exacting requirements of railway service, with its issues of safety to life and limb involved, call for an organization of instrumentalities which must be far more perfect and reliable in operation than in any other department of electrical work.

Mechanical ingenuity of the highest order has heretofore been displayed in the various devices and arrangements employed, but the attainment of success under such circumstances must depend upon the greatest possible simplicity of mechanical construction and certainty of electrical action, rather than upon complicated machinery, however ingeniously arranged, which will afford a hundred points for faulty operation.



Hadden's Automatic Railway Signal.

Among the names of the electrical inventors who have made the subject of railway signaling a study, we find that of Mr. William Hadden, of this city, who is the inventor and patentee of several systems of automatic railway signals, one of which is now in successful operation upon the Tyrone branch of the Pennsylvania Railroad, and also upon the Chicago, Burlington and Quincy Railroad in the West, which, it will be seen from the following description and diagram, fairly merits praise for extreme simplicity of arrangement :

The system consists of a circuit of one wire, with one battery, upon which any number of signals may be placed, which may be operated from either end of the section of road to be protected, and at any number of intermediate points as may be required. The normal position of the system is at "safety," or the signal banners out of sight, which is obtained by the full power of the battery actuating the signal magnets. When a train enters a section thus guarded, an instrument, A, connected with the track, breaks the main circuit, which causes all of the armatures of the signal magnets to be retracted. This movement of the armature levers changes the circuit, introducing one set of resistance coils, R, R′ into it at each end of the section, so reducing the power of the battery that the magnets cannot attract their armatures, although the circuit breaker, A, is immediately closed, the signals thus remaining in sight, or at "danger," protecting the train both in front and behind. As the train, in its forward progress, leaves the section at the opposite end from which it entered, another track instrument, B, is operated, which "cuts out" the resistance at that end of the circuit. The removal of this amount of resistance is sufficient to enable the battery to actuate the magnets, which action will also remove the resistance at the other end of the circuit, when the signals will be held firmly out of sight, or at "safety." It will be seen that the operation will be the same if the trains enter the section at either end. In case it is required to operate the signals from a number of intermediate points of track interruption, such as draw bridges, branch roads, etc., the electrical circuit is connected with the bridge or road switch, as shown at C. When the switch is thrown over to its furthest limit, the circuit is open, and, of course, all signals are at once set to "danger." When it is desired to replace them to "safety," the switch is turned back to its first position. But during this backward movement of the switch, a new circuit is formed, which removes all resistances lying beyond it, and enables the resistance controlling magnet at the battery end of the line to act, such action cutting out the resistance placed there. In the further movement of the switch, the original position is regained without breaking circuit, and all signals come to "safety."

A great point of advantage in this system is, that the track instruments can be placed at such distances from each other that the signals will indicate when a train is entering or leaving the section, and will not come to rest until the whole train has come upon the section, or left it; thereby overcoming the serious objection that the engine will set the signals to "safety" while a long and slowly moving freight train still remains upon the section.

The track instruments used are of simple construction, and ingeniously arranged to overcome the difficulties which arise from being placed where they are liable to be submerged in water in wet weather, or covered with dust and cinders when it is dry, and being continuously subjected to the trip-hammer-like pounding of forty ton engines of lightning express trains.

With a cheap and reliable system of automatic signaling, such as this appears to be, there should be no excuse for any of the accidents resulting from collisions, as they would certainly be prevented by its use.

PROF. AMOS E DOLBEAR made a communication before a recent meeting of the American Academy of Arts and Sciences, upon a method of electric signals between a vessel at sea, in the track of an ocean cable, and the shore.

A large plate attached to an insulated conductor reached from the vessel to the bottom, and another plate is merely submerged. Between these conductors is a battery and Morse key. By interrupting the battery circuit with the key, corresponding induced currents are produced in the cable, and would affect hand telephones at the shore ends of the cable.

To signal from the shore to the vessel, use the Morse key on shore, and the hand telephone on the vessel.

—— AT A RECENT MEETING of the Académie des Sciences, the Secretary reported that Mr Mauser had succeeded in transmitting a message through a hundred telephone wires to as many destinations at once.

THE BALL UNIPOLAR DYNAMO MACHINE.

WE are indebted to several of our English cotemporaries for much interesting information, in regard to what has been done in this city with Mr. Ball's so-called unipolar dynamo machine. Very little has been heard on this side of the water, in regard to this machine, but we are now informed that it has been in use here for some time, and has produced quite remarkable results. One of these machines has recently been taken to England, and a full description of it has been given in several of the leading scientific papers.

As it is frequently of great value to know what not to do, some general consideration of the principles involved in the construction of this machine, may be of service to our readers. The following cuts are reproduced from an article published in the *Engineer:*

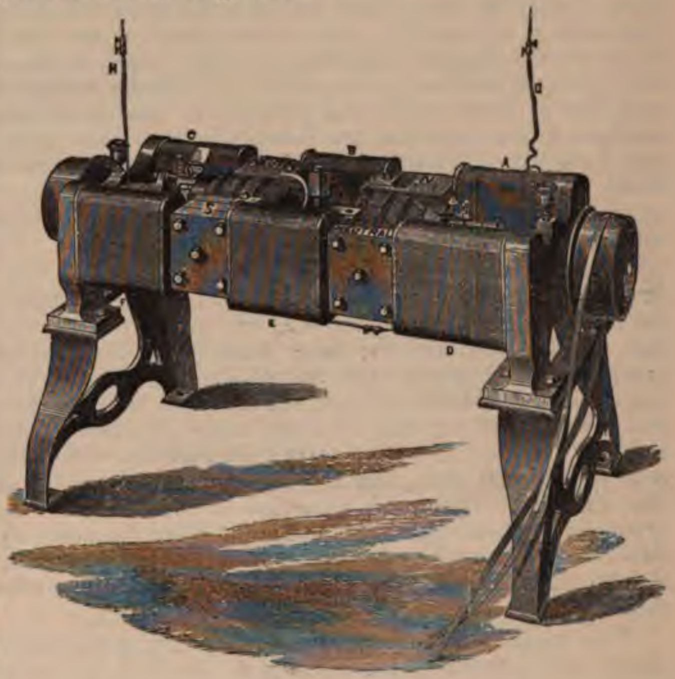


FIG. 1.

The distinctive features of the machine appear to be the use of two armatures, and an arrangement of the field magnets, in such a manner, that a single pole only is presented to each armature; the winding of the field-coils being so arranged, that the place ordinarily occupied by the second pole of the field, is made a neutral point. This is best shown in Fig. 2, which is a diagram of the arrangement of the field and armatures, and the connections of the circuit. Exactly what advantage the inventor expects to obtain from this arrangement is not very clear; but the following extract from the specification of his English patent, may throw some light on the subject:

"Heretofore, dynamo-electric machines have been so constructed, that the armature revolved in the field, or within the inductive influence, of two or more poles of a magnet or magnets. The communicator of this invention has discovered, that by employing only one pole of the field-magnet, or what amounts to the same thing, arranging the armature to rotate within the inductive influence of only one pole of the field-magnet, vastly improved results can be obtained; that is, that greater quantity and increased intensity of current are secured, while at the same time the armature will require very much less power to effect its rotation, than would be necessary if rotated in the field of two or more poles.

"Hence this invention consists partly in the arrangement, in a dynamo-electric machine, of an armature rotating in the field of only one pole of a magnet.

"The said communicator has further discovered that by constructing a dynamo-electric machine with two armatures, each of which revolves within the inductive influence of only one pole of a magnet, and connecting the magnet and armature helices in one circuit, the quantity and intensity of currents generated, will be vastly increased.

"The said invention, therefore, further consists partly in the combination, in a dynamo-electric machine, of two or more armatures, each arranged to rotate in the inductive field of only one pole of an electro-magnet, both of said armatures and the magnet being in the same circuit.

"In carrying the said invention into practice, I provide a frame consisting of an iron base, with two uprights or end pieces of the same material securely bolted to said base. There are two parallel bars of soft iron sustained by their ends in the uprights; these bars constitute the cores of the electro-magnets composing the field. Each of these bars is wound with wire to form helices. To the inside of each bar is fastened an iron pole-piece; two shafts are arranged in the same line, but independent of each other, each having a pulley whereby said shafts, and the armatures which they carry, can be rotated in opposite directions—*i.e.*, one shaft in one direction, and the other shaft in the contrary direction.

"I provide armatures of any ordinary or suitable construction carried on the shafts, and located within the inductive influence of the poles—*i.e.*, one armature is in the field of one pole, and the other armature in the field of another pole. I also provide suitable commutators. The connections established in one manner with unlike poles, make the derived currents all of the same direction in the external circuit. By altering the connections, the poles may be rendered alike, and the current still preserved of like direction. Hence my invention is not limited to an arrangement involving unlike poles; but when the poles are alike, the armatures should revolve in the same direction, in which case they may be mounted on one shaft, or on independent shafts.

"By locating the armatures, however, on independent shafts, and connecting the same with the field, the armatures mutually assist the rotation of each other. As soon as the power-driven shaft acquires speed, and generates a current, such current, passing into the field, magnetizes the pole-piece of the armature on the other shaft, and by induction produces a rapid rotation of such other armature and shaft. When power is applied to both shafts, the armatures mutually assist each other in like manner, the result being that the machine may be driven by relatively very much less power, than is required for any other known dynamo-electric machine capable of generating the same amount of electricity."

From the last paragraph, the original idea of the inventor would seem to be, that by making the armatures revolve in opposite directions, they would be made to mutually assist each other in such a way, as to greatly diminish the power required for driving the machine, or dispense with it altogether.

With regard to the subsequent modification of the machine, a writer in the *Electrical Review*, says: "From what we can gather, concerning Mr. Ball's experiments, it appears that when his machine was first tried, it failed to give any external effect, either through wrong connections, or through the current from one armature opposing that from the other. Afterwards a good result was obtained by revolving the armatures in opposite directions, but it was then found that the connections of the electro-magnets were so arranged, that at one side of each armature was a neutral point. These mistakes, if such they may be called, seem to have had the effect of inducing Mr. Ball to abandon one pole-piece of each armature entirely; the result being the machine forming the subject of our article."

It requires little technical knowledge to see that the mutual assistance theory of the machine is an entire fallacy, as no such action could possibly occur, except at the expense of a corresponding diminution of current in the external circuit of the machine.

The arrangement of field and armatures, adopted in the present machine is, so far as we know, novel with Mr. Ball, but we venture to suggest, that one reason why his modifications of the Gramme machine have not been used before, is that their only effect is to diminish the efficiency of the machine. Indeed, it seems to us, that Mr. Ball is entitled to the credit of having got the Gramme machine into so bad a form, that it would require considerable ingenuity to render it much worse. What advantages can result from the use of two armatures instead of one, and a dispersion of the field rather than concentration, we are not able to discover, but the disadvantages are apparent upon the most casual examination of the subject, and are, as it seems to us, very serious in their nature.

The efficiency of a dynamo machine depends largely upon the development of high electro-motive force, per unit of length, of the armature conductor. The electro-motive force, developed with a given length of armature conductor in any machine, depends principally upon the speed of rotation of the armature, and the strength of the magnetic field in which it moves. As there are practical limits, beyond which it is not advantageous to go in practice, in increasing the speed of the armature, the designers of all the dynamo machines, which are now producing good results in actual use, have endeavored, as far as possible, to increase the strength of the field. A very slight consideration of the problem, is sufficient to show that this is best accomplished by bringing the two poles of the field into such relation with the armature, that the armature acts as a keeper for the magnetic system constituted by the field magnets. With this arrangement, all the lines of force of both poles are concentrated upon the armature, and pass through it to reach the other pole, so that the armature conductors cut nearly all the lines of force developed by the field.

In designing the machine, which we are now considering, Mr. Ball has, apparently, carefully avoided taking advantage of this construction, and has so arranged the poles of the field, that the lines of force passing from one pole of the field to the other, have to follow devious paths, in which magnetic material is not continuous, With the arrangement shown in the cuts, it is evident that the two poles of the field system can exert very little, if any, mutual action, and the lines of force proceeding from them are, accordingly, not concentrated, but dispersed. The arrangement shown, also involves mechanical difficulties, which must prove very serious. It will be observed, that by presenting only one pole of the field to each armature, the armature is powerfully attracted toward the pole, and the whole strain of this attraction is brought to bear transversely upon the armature shaft, while in the machine, as ordinarily constructed, the attraction in one direction of one pole of the field, is counterbalanced by the attraction in the other direction, by the other pole.

The duplication of armatures and commutators, is also extremely objectionable, and, as it seems to us, a modification entirely in the wrong direction. The machine would be greatly improved by suppressing all of the novel features, and returning to the ordinary construction, and we have no doubt that one of the armatures would do all the work that both do under the present arrangement, and in a more efficient manner, if the field were so arranged as to present both poles to it in the ordinary manner.

Mr. Robert Sabine has been employed by the promoters of the enterprise in England, to make electrical tests of the machine, and the following extract from his report shows the results obtained:

"When I tested the system, the dynamo was run with six arc lamps, also said to be of Mr. Ball's invention, the dynamo being worked on the 'series' system, that is to say, field-magnets, armatures, and lamps, all joined up in series. The speed of the machine was not so regular as could have been desired, and the Morin dynamometer, by which the power given to the dynamo was measured, would have worked steadier, had it been driven quicker, or with a heavier load.

The following are the mean results which I found:

Current in circuit, $c = 15.0$ ampéres.

Potential difference between terminals, $e = 195$ volts.

Resistance of dynamo, $r = 4.5$ ohms.

Speed of dynamo, 1,650 to 1,715 revolutions per minute.

Speed of dynamometer, $s = 332$ revolutions per minute.

Indicated pull on dynamometer, less pull when circuit open, $k = 52$ kilos.

From these values—

(1). Given to dynamo for electrical work,

$$\frac{1.5\ k\ s}{60 \times 76} = 5.68 \text{ h. p.}$$

(2). Accounted for in outer circuit,

$$\frac{E\ c}{746} = 3.92 \text{ h. p.}$$

(3). Accounted for in inner circuit,

$$\frac{c^2\ r}{746} = 1.35 \text{ h. p.}$$

The proportion accounted for electrically, therefore, $\frac{5.27}{5.68} = 0.92$, of which $\frac{3.92}{5.68} = 0.69$, was accounted for in the lamps. This would leave only 8 per cent. for the so-called Foucault currents.

Photometric measurements were made with one of the lamps, placed apart from the others in a dark recess, the light of the five remaining lamps not being measured.

The following mean results were obtained during the observations:

Current in lamp, 13.9 ampéres.

Potential difference, 40.1 volts.

Accounted for in lamp, $\frac{13.9 \times 40.1}{746} = 0.75$ h. p.

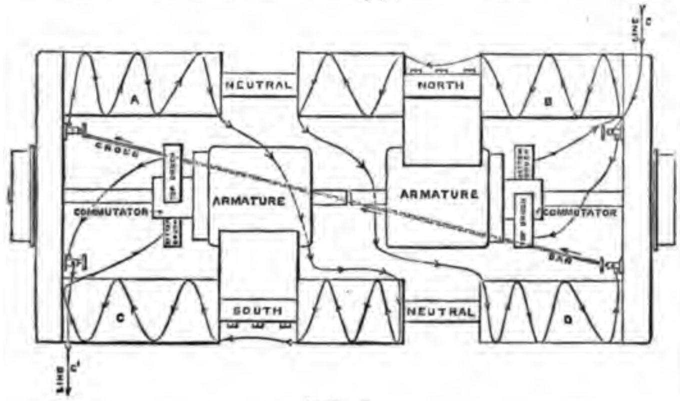


FIG. 2.

From this it will be observed, that the machine was run at an extremely high speed, 1,650 to 1,750 revolutions per minute. The measurements made, apparently take no account of the loss by friction in the machine, which must be very considerable. It will be observed, that the power absorbed, was obtained by deducting the amount required for running the machine with the circuit open, from the amount required for running it with the circuit closed. Even under these conditions the tests show a very low efficiency for the machine; the gross efficiency being 92 per cent., and the net efficiency 69 per cent. Some of the machines with the ordinary bipolar field, and a single armature, which are now in common use, show a net efficiency of over 90 per cent., even running at a considerably lower speed.

The results of Mr. Sabine's measurements, do not appear to point to any different conclusion from that we have ventured to suggest upon theoretical grounds.

NEW YORK ELECTRICAL SOCIETY.

AT the meeting of the New York Electrical Society, Friday evening, April 6th, it was decided to make its library a circulating one.

Mr. F. W. Cushing described the latest developments in harmonic telegraphy, and Mr. C. O. Mailloux read a paper, by Mr. George A. Hamilton, entitled "On a Simple Formula for Determining the Insulation of a Section of Wire, Measured through an Intermediate Lead."

At a meeting of the society, on Friday evening, April 20th, at the Stevens Institute of Technology, at Hoboken, Prof. Henry Morton read an important paper on "The Storage of Electricity." Edison lamps lighted the room, a two horse-power Weston electric motor stood on the lecture table, and the lamps and motor were furnished with electricity from the Selon-Volckmar accumulators. The structure and principles of the accumulator were fully explained, and many interesting experiments made by the lecturer. We much regret that the text of this lecture was received too late for our present publication, but we will hope to refer to it hereafter.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(Continued from page 106.)

THE UNIVERSAL STOCK TRANSMITTER.

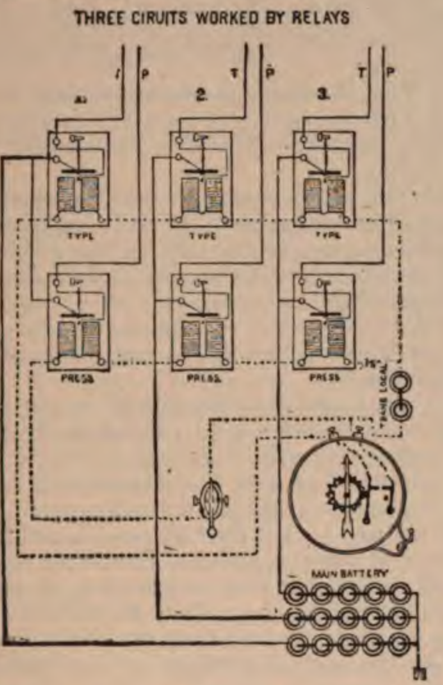
THERE are two forms of transmitters used for the universal instruments, one called the "hand" transmitter, and the other the "automatic" transmitter. The original form is called the "hand" or "crank" transmitter, and is still used in some of the cities throughout the country, where small installations are required. It possesses a great advantage in simplicity of construction, thus doing away with the necessity for especially trained or skilled employés, while its disadvantages are slowness, and, what is a worse quality for printing instruments, irregularity in speed. In the hand transmitter the speed is entirely controlled and regulated by the operator, just as in Morse sending, and is, therefore, subject to the changes produced by the temperament of the operator, so far as he may be affected by local and transient circumstances, such as a "rush" of business, distracting sights and sounds, etc.

The hand transmitter consists of a crank-handle, and crank-shaft, geared to a large wheel, so that rotation of the crank produces rotary motion of the large wheel in the ratio of four turns of the crank for one of the large wheel. A ratchet-wheel, click and spring, communicate the movement from the crank-handle to the crank-shaft, so that an accidental backward rotation of the former has no effect on the latter. The large wheel occupies the central portion of a horizontally placed dial plate, the circumferential portion of which is divided into thirty divisions, arranged in the same order, and containing the same characters as are engraved on the peripheries of the type-wheels of the instruments. On the top of the large wheel, and rigidly fixed to it, is a pointer extending across the whole face of the dial, carrying at one end an arrow-head, and at the other a fish-tail, or other distinguishing design. The pointer, or arrow, revolves with the large wheel, and serves to indicate to the operator which letter or figure on the type-wheels is opposite the printing pads of the instruments. The characters on the dial are as follows, and are placed in order here given, traveling in a circle from the spot where the letters XII are in an ordinary clock, in the left-hand direction around the circle, to the same spot again. Each space contains two characters, viz.: one letter and one figure—

• A B C D E F G H I J K L M N O P Q R • S T U V W X Y Z & •
• 1 2 3 4 5 6 7 8 9 0 C ⅛ ¼ ⅜ ½ ⅝ ¾ ⅞ S • ⅛ ¼ ⅜ ½ ⅝ ¾ ⅞ B •

The object of engraving both the figures and letters on the same dial, is simply to avoid the necessity for using two dials. The dot at the beginning of the series of characters, is the letter-shifting dot, that is, the one on which the type-wheels can be shifted to print letters; and the dot at the end of the series is the figure-shifting dot. It will be observed that there are some letters, viz.: C, B, and S, in the figure series. They are technically known as "figure C," "figure B," and "figure S," respectively, and are placed there, because they are required to be used frequently, mixed with the figures, in ordinary stock quotations, where C, means "Cash;" B, "buyer" or "bid;" and S, "seller."

The function of this transmitter is to send over the main lines the successive pulsations or waves of current which rotate the type-wheels of the instruments, and to enable the operator to know, by inspection of the position of the arrow on the dial, the position of the type-wheels of the instruments. The special portions of the apparatus by which these results are secured, are as follows: the large wheel, already alluded to above, has on its periphery fifteen teeth; a pivoted lever, carrying a wedge-shaped piece on one side, and a platina point on the other side, is normally held by a spiral spring, with the wedge-shaped piece in a notch between two of the teeth in the wheel; when the wheel is revolved, the platina point on the lever is pushed against another platina point on another pivoted arm, also pulled towards the wheel by a spiral spring, but prevented from touching the point on the lever, when the latter is between two teeth, by a limit pin fixed in the dial plate; when the wedge-shaped piece on the first mentioned lever falls into a notch between two of the teeth in the wheel, the platina points are separated, and the second arm falls against the limiting pin fixed in the dial plate; the result will be that by one revolution of the wheel, a circuit passing through the platina points will be closed fifteen times, and opened fifteen times; in order to work several circuits, the wires connecting with these two points, are led through a "relay local" battery, and the magnet coils of a set of [illegible] called the "type-relays," one of which is required for [illegible] circuit; the ordinary contact points of these [illegible] the main batteries to the type line wires of [illegible] circuit respectively. Now let us suppose all of [illegible] to be at rest, with all of the "letter" dots [illegible] opposite the paper, and in a position to [illegible] and the pointer of the transmitter to be [illegible] "letter" dot on the dial; if the operator [illegible] and revolves the big wheel, so as to [illegible] the A on the dial, the first tooth [illegible] under the pivoted lever, and [illegible] the latter against the other [illegible] thus closing the local [illegible] the magnets of all [illegible] the type-relays, being [illegible] the type-wires of the main lines, and, in consequence, the type-magnets of the instruments will attract their armature-levers, causing the upper pallets of the latter to be brought down against the side of a tooth on the escape-wheels, thus pushing the latter forward $\frac{1}{16}$th of a revolution. The type-wheels fixed on the same shafts as the escape-wheels, will be rotated through the space occupied by one letter, and the letter next to the dot, viz.: A, will be brought opposite the paper. If the operator then moves the crank, so as to rotate the big wheel and pointer, till the latter is opposite letter B on the dial, the platina-pointed lever will fall into the space between the first and second teeth on the large wheel; the second platina-pointed lever will follow the first one until it is stopped by the limit pin, and then the points will be separated; and the type-relay local circuit will be opened at these points. The type-relay magnets then lose their magnetism, their armatures will be withdrawn by their retracting springs, and the main circuits will be opened at the relay points; the type-magnets of the instruments will lose their magnetism, the levers will be withdrawn by their springs, and the lower pallets will strike against the side of a tooth on the under side of the escape-wheels, and the escape and type-wheels will be rotated through $\frac{1}{16}$th of a revolution, and the next letter on the type-wheels, viz.: A, will be brought opposite to the paper, in a position to be printed from; by successive actions of the nature just described, the type-wheels may be rotated to any letter or figure in unison with the pointer on the dial. The dial is placed in front of the transmitting operator, in a position to be conveniently worked by his right hand; on the left hand side of the dial, placed so as to be readily operated by the left hand of the operator, is an ordinary Morse key with the circuit closer removed; a wire from one of the poles of the relay local battery connects to the lever of the key, while the lower contact is connected to a wire which completes a circuit through the magnets of all the press-relays, and thence to the return wire from both the type and press-relay magnets back to the other pole of the relay local battery. When the operator has rotated the pointer to the letter or figure on the dial which he wishes to print he stops the pointer there, and while it remains stationary he depresses the Morse key-lever, and if he wishes to repeat the same letter he touches the key again as often as may be required. The press-relays then attract their armatures, thus bringing the press-relay points in contact; as each press-relay armature-lever is connected to a branch wire from the main battery for that circuit, while the lower contact is connected with the main press-line wire of that circuit; the result of this action is, that all of the printing magnets of the instruments attract their armatures, the printing pads press the paper against the type-wheels, the letter on the type-wheel which is opposite the pad, is then printed, and the paper fed out far enough to leave a proper margin and blank space for the next letter to be printed on. The method of shifting the type-wheels having already been described, it only remains to be said, that when the operator wishes to print letters, he first revolves the pointer to the "letter dot," and then depresses the printing-key, thus shifting the type-wheels to a position in which the letters are opposite the pad; and when he wishes to change from letters to figures, he first revolves the pointer to the "figure-dot," and depresses the key, when the contrary action takes place; as each key represents either a figure, or a letter, at will, it is necessary for the operator to bear in mind whether he is printing letters or figures, and to avoid transferring his attention from one to the other, without first touching the appropriate shifting-key, otherwise the instruments will print a letter A, when the operator intend them to print a figure 1, and *vice versa*; to set the type-wheels at unison, the operator simply revolves the pointer four times, without touching the press-key, and then leaves the pointer at rest at the "letter dot," when all of the instruments will be automatically brought into unison with the pointer. The following diagram shows the main and local connections for three circuits, worked by a hand transmitter:



A description of the improved automatic transmitter will be given in our next article.

AEROSTATIC ELECTRICITY.

THE ascension of the balloon, the *Horizon*, which took place from the gas works at Villette at noon, terminated at midnight in a fir-wood on the left bank of the Aar, a few leagues from Aarau, capital of the canton of Argovia. We will not discuss the construction and manœuvring of this balloon here, but limit ourselves to congratulating the organizers on having followed the example of the ascension of *La Comète de* 1882, in having taken incandescent lamps with them.

It appears that there were three lamps, fed by a bi-chromate battery, and that they worked admirably from 7 o'clock p. m. until the end of the journey.

It is thus seen, that the use of electricity for balloon ascensions is becoming generalized, and it may be assumed, that no more nocturnal ascensions will be made without them. But it would be an error to believe that the use of electricity in the dark regions of the sky is limited to giving a cheerful light. The bi-chromate battery is sufficient to support an electric lamp in the outside car, which can be used for illuminating suspicious objects, and facilitating a safe descent. The electric current can also be made use of to warm the ærostats by means of small platina spirals inclosed in glass tubes, and which can be placed in direct contact with the hands or feet. "However feeble may be the heat of the Swan lamps, it can be used to give a very comfortable degree of heat, by having the glass thicker than in ordinary lamps."

The light, graduated by a rheostat, serves to study the stars, while the motive power may be utilized to arrest the rotation of the balloon, as well as to cause it to rise or fall—the dynamic effects being, of course, subordinate to the power of the battery. The electric power could only be used as a regulator, and not be forced out of its real *rôle*. The acidulated water must, however, be well placed, and if it is to be used as ballast, means must be adopted to get rid of it easily.—*L'Electricité.*

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

X, PART II—EARLY THEORIES OF ELECTRICITY.

Electricity endured the patronage, during the last century, of a great number of imponderable

FLUID HYPOTHESES,

among which that of the Abbe Nollet, who recognized in the light which envelops electrified bodies the matter of electricity entering or going out, as shown in Fig. 52, was conspicuous. He denominated the two simultaneous movements, affluence and effluence, and explained by them the greater part of the electrical facts then known, with a certain facility of language. Attractions and repulsions were, for Nollet, the result of impulsions given by the movement of the electric particles, as is indicated in Fig. 53.[10] Watson, in 1747, thinks he proves afflux and efflux, and uses the term electric ether to signify the atmosphere around an electrified body.[11] Nollet says, in his letter to Franklin, July 1, 1752, "It may be added that the affluent matter is the only one that can be contested; as for the effluent matter, everybody is convinced of it."[12] But the discovery of the Leyden Jar upset the theory, and hypotheses less crude prevailed.[13]

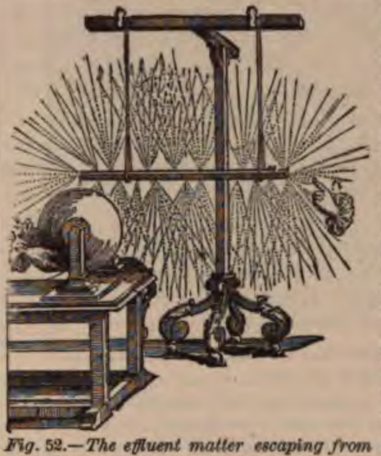


*Fig. 52.—The effluent matter escaping from a prime conductor, according to Abbe Nollet.**

Among less important fluid theories, several were suggested, which were but effluvial hypotheses revived under new terms. Ellicott regarded the surface of an electrified body as surrounded with a subtile matter, always in movement, for as soon as fragments of leaves of gold approach such an excited electric they are agitated in all manners.[14]

But more important fluid theories have so impressed themselves upon electrical history that their terms are everywhere employed, and first among them was that of Franklin, which "gave way only when the calculations of Aepinus showed that to explain the repulsion of bodies electrified negatively, it was necessary to consider the ponderable molecules of bodies as endowed with a repulsive, instead of an attractive tendency, which is contrary to all molecular phenomena."[15]

"So, failing to progress with one fluid, two were imagined, and by attributing to them a sufficient number of specific qualities, Symmer, upon the discovery of Du Fay, founded the two-fluid theory, and obtained a result more satisfactory. But it is evident upon analysis, that in their most complete development these theories merely imitate the phenomena of electricity as an automaton imitates life. The theory of Symmer involved the existence in all bodies of two fluids in equal quantities and intimately combined. Each is self repulsive and attractive of the other, while both have an attraction for the molecules of material bodies. This hypothesis explained the ordinary electrical phenomena. Poisson submitted it to calculation, and by establishing it as an admirable mathematical theory, the formulas of which accord with the previous experiments of Coulomb, he gave it a prestige, which led to its general adoption for a long time. But as science progressed, all the fluid theories were found defective and gradually retired, though they are still used as a symbolism to aid the memory.[16]

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* From Nollet's Essai, &c. A. La Haye. 1747.

[10] Cazin. Les Forces Physiques. Paris, 1869. P. 259.

[11] Phil. Trans. 1747. No. 484, p. 738; also pp. 730, 731, and 748.

[12] Franklin. Loc. Cit. Ed. of 1856. P. 496.

[13] Cazin. Loc. Cit.

[14] Ellicott. Phil. Trans. 1749.

[15] Cazin. Loc. Cit. For Franklin's theory, see ELECTRICIAN, Vol. II, p. 47.

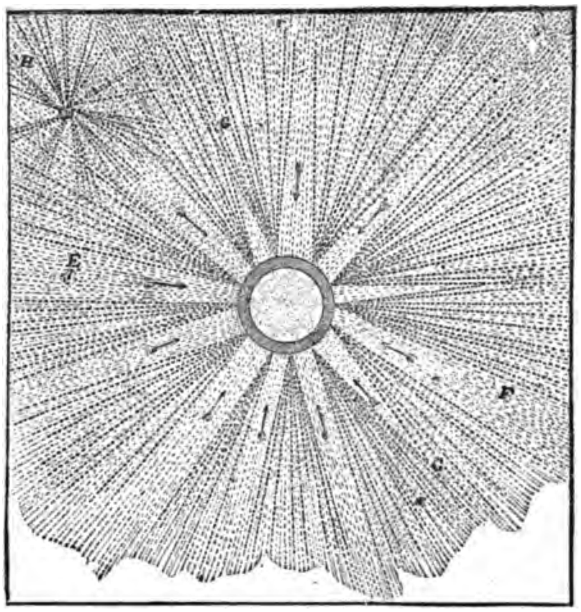

Fig. 53.—Abbe Nollet's explanation of attraction and repulsion. The diverging rays represent effluent electricity; the intermediate spaces, designated by arrows, affluent electricity. A small object, H, caught in one of the latter streams, is carried toward the electrified body.†

As they declined, the

ETHERIAL HYPOTHESIS

prevailed, of which, in its first form, Benjamin Wilson and Dr. Hoadley, in 1756,[17] say: "thus, from the various appearances electrical experiments afford, it appears that the electrical fluid is as universal and powerful an agent near the earth, as that fluid which Sir Isaac Newton, in his Optics, calls aether." We shall make no scruple, therefore, now to affirm that the two fluids are one and the same fluid; and it is much more philosophical to do so than to suppose two such fluids, each of them equally capable of producing those effects, and equally present everywhere, which would be multiplying causes where there is no manner of occasion."[18]

Mr. Benjamin Wilson, supposing that electrified bodies receive an additional quantity of electricity, invented the term "accumulated," now so much employed with reference to so-called storage batteries, and also invented the word "circuit," to designate the chain of conductors traversed by electricity from one place to another.

In 1753, the Abbe Nollet concluded the analogy of aether with fire as proved,[19] and gave publicity to a suggestion which, in 1774, Mr. R. Lovett modified to a second form of the ethereal hypothesis, called the pneuma or

COLD FIRE HYPOTHESIS,

which positively characterized the nature of the long popular electric fluid. It resembled the ethereal hypothesis in claiming the universal diffusion of a subtile matter, and is best explained by Lovett's six fundamental articles:

"(1st.) That in the beginning, the All Wise and Omnipotent Creator of all Things formed an universal Aetherial Fluid or primary Air, endowed with the utmost purity, subtility and rarity.

"(2d.) That the whole universe is replete with it.

"(3d.) That the Aether or pure Air is universal, not only in all open spaces, but in the Minutest vacuities of the most compact Bodies.

"(4th.) The Earth is endued with a property of Transpiration, or of breathing forth the most Volatile parts of it to a considerable height from its surface. Those effluvia become blended, incorporated, and most intimately mixed with Particles of the universal pure Aether or primary Air, and by that means constitute a secondary Air (the atmosphere) or aerial Fluid, and the only one that could (till now) be proved to exist.

"(5th.) That from the elasticity of its particles ariseth an intumescence, a swelling or expanding Property, and a constant endeavor of extending their Limits to greater Dimensions; Hence they, and consequently all masses composed of such elastic particles, mutually repel.

"(6th, and last.) That this universal Air, although invisible, is nevertheless true, and real Fire in the strictest sense of the word. This true Fire is either hot or cold, according to the temperature of the Body in which it exists."[20]

"Heat is an accidental property of fire, generated at pleasure by the mutual attrition of the particles of the fire."[21]

Lovett calls the air pump the pneumatic engine, and the electrical machine the electrical engine, since one pumps the mixture of effluvia and aether or fire, called the atmosphere, and the other the pure aether or fire itself.[22]

Such was probably the sequence of phases of thought through which physical philosophy, and with it electrical philosophy, has been conducted,[23] "but parallel with the idea of imponderable fluids and condensed ether acting under the impulses of forces unknown, a more simple hypothesis developed, which, in various forms, has existed since early Greek antiquity, when Epicurus described a doctrine advanced by Lucreece, that depicts the ůniverse as an assemblage of visible masses, obeying the impulsion of masses infinitely tenuous and invisible, traversing space with enormous celerity, and producing, by collision with the former, all the phenomena of gravity, heat, light and electricity. Among these, the system of vortices of Descartes, was one of the most ingenious, but never impressed itself upon modern science, even as a symbolism."[24]

The ethereal hypothesis gradually merged into a new form of this old doctrine,[25] the

MODE OF MOTION HYPOTHESIS,

still maintaining the existence of an ether, associated with motion as an essential attribute. Thus, Benjamin Wilson, in a work dated 1752, says: "When we hereafter speak of electric matter, we would be understood to mean the aether put into such a motion within a body, as to carry along with it sulphur and other gross matter. But when we speak of the aether, we mean the same fluid, but not put into that degree of motion."[26]

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† From Nollet's Essai, &c. A. La Haye. 1747.

[16] Cazin. Ibid.

[17] Dr Hoadley and Mr. Benj. Wilson. Observations on a Series of Elec. Experiments. London, 1756. P. 68.

[18] Wilson. Electrical Experiments. London, 1752.

[19] William Watson. Review of Nollet's Letters to Benj. Franklin. Phil. Trans., 1753, p. 201. Second Letter, p. 208 See also Jean Paul Marat, Researches Physiques sur le Feu. Paris, 1780. Plate IV.

[20] R. Lovett. The Electrical Philosopher. Worcester, 1774. P. 8.

[21] Ibid. P. 8.

[22] Ibid. P. 237.

[23] Grove. Loc cit.

[24] Cazin. Loc cit.

[25] Otto Guericke. Ex. Nova Magdeburgica Bk. 4. Winckler, M. F. H. Essai sur la nature les effets et les causes de l'electricite. Paris, 1748.

This crude conception was one of many steps toward the modern hypotheses, which regard electricity generally as a mode of motion, some specifically as a polar oscillation,[27] and which, requiring no improbably qualified ethereal fluid, tend now to substitute for the ether an extension of the atmosphere itself.[28] [29]

LAYING WIRES UNDERGROUND.

THE Gramme Electrical Company has taken the initiative, in regard to a thorough examination of the question of underground electrical communication, with a view to the adoption of some efficient system, which can be made use of by all of the various electrical companies now doing business in this city.

Some time since, invitations were sent by the Gramme Company, to the Western Union, the Baltimore and Ohio, the Mutual Union, the American Rapid, the Postal, the Bankers and Merchants, and the Gold and Stock Telegraph Companies; the Metropolitan Telegraph and Telephone Company; the Manhattan, and Mutual District Messenger, and the American District Telegraph Companies; the Law Telegraph Company, the Holmes Burglar-Alarm Telegraph Company, and the seven electric lighting companies embraced in the Gramme organization, to attend a meeting on April 20th, to be held for the purpose of considering the subject of joint action by all the companies interested.

Representatives of nearly all the companies attended the meeting, and also quite a number of prominent scientific men.

After some discussion, the following resolutions were adopted:

Resolved, That, in the opinion of this meeting, the time has arrived when it is expedient to make an exhaustive examination of all devices and inventions pertaining to the subject of underground electrical communication, with a view to determine whether any inclusive system can be found which will enable the electrical corporations to establish such communications.

Resolved, That it is the sense of this meeting, that the public desire to relieve the thoroughfares from poles and wires, is quite in accord with the wishes of the corporations, and that the true interest of the shareholder is to be found in a permanent, inclusive, and protected system.

Resolved, That the problem presented to the corporations and the electrical engineers, is complex and difficult, and, in the opinion of this meeting, has not yet been fully solved; that any system to be adopted must combine the highest efficiency with reasonable economy, and serve inclusive interests; that while it is, perhaps, possible for trunk line telegraphs to avail themselves of existing devices, it is not possible, in the present state of the art, for services connecting every house in the city so to do, without an expenditure so vast as to be prohibitory in most instances, and that, therefore, hasty compulsory legislation is to be deprecated, as being destructive to useful and indispensable public conveniences.

Resolved, That a committee be appointed by the chairman of this meeting, either now or hereafter, at his option, consisting of one delegate from each electrical corporation invited to be present at this meeting, the Governor of the State and Mayor of this city, with power to add to its number, which committee shall be authorized to examine the subject in respect to its scientific, mechanical, legal, and financial considerations, with power to adopt such course of procedure as may appear advisable to it, after such examination; and, with the approval of the respective corporations, form a company in the collective interest, and consider such inventions and devices in that behalf as may prove to be indispensable to a successful installation.

A meeting of the general committee was held at room 47, No. 115 Broadway, at 11 A. M., April 25th.

The committee consists of the following gentlemen:

Time Telegraph Co., H. L. Bailey, Electrician; Automatic Signal Telegraph Co., A. C. Richards, Treasurer; Metropolitan Telephone Co., J. P. Davis, Vice-President; Law Telegraph Co., W. A. Childs, Manager; Edison Electric Light Co., S. B. Eaton, President; Manhattan District Telegraph Co., H. W. Pope, Vice-President; Mutual District Messenger Co., C. B. Hotchkiss, Vice-President; Brush Electric Co, T. J. Montgomery, Vice-President; Western Union Telegraph Co., D. H. Bates, Vice-President; Fuller Electrical Co., A. B. Chandler, President; Weston Electric Co., C. R. Flint; Baltimore and Ohio Telegraph Co., C. W. Price, General Manager; Jablochkoff Electric Lighting Co., W. M. Ivins, President; American Rapid Telegraph Co., F. H. May, General Manager; Holmes Burglar-Alarm, E. Holmes, President; Gramme Electrical Co., R. R. Hazard, President; Postal Telegraph Co., H. Cummins, Vice-President; Bankers and Merchants Telegraph Co., G. S. Mott, S. S.; American Electric Co., Elihu Thomson, Electrician; United States Electric Lighting Co., L. E. Curtis, Secretary; Fire Department Telegraph, Eliot Smith, G. S.; the State of New York, Grover Cleveland, Governor; the City of New York, Franklin Edson, Mayor.

Representatives of the Gold and Stock Telegraph Co., the Mutual Union Telegraph Co., and the American District Telegraph Co. have yet to be appointed.

The committee was organized as follows:

Chairman, J. P. Davis; Treasurer, R. W. Blackwell; Secretary, W. C. Behrens.

Mr. J. P. Davis, Vice-President of the Metropolitan Telephone and Telegraph Co., Col. R. R. Hazard, President of the Gramme Electrical Co., and Mr. Frederick H. May, General Manager of the American Rapid Telegraph Co., were appointed to present nominations at the next meeting for the permanent sub-committees.

Mr. Robert B. Minturn said: During the past week I have been in conference with members of the Legislature with reference to the bill, now before the Assembly, compelling companies using wires to place them underground. It is my belief, I am glad to say, that that measure will not pass at this session. I am satisfied, however, that a majority of the Legislature are in favor of the adoption of some similar bill. The efforts of those who are thoroughly convinced of its inexpediency and injustice, have alone prevented its passage. We must recognize the fact that this feeling in the Legislature is a genuine and honest one, and actuated by public spirit, though the lack of proper information on the subject makes it extremely liable to injure great public interests. There has been a lack of interest shown in this city; a general feeling among the companies that no such ill-advised and injurious measure can possibly pass, but we must consider that the Legislature, and the public, are almost wholly ignorant of the difficulties to be surmounted.

In the common interest, I urge the necessity of supplying the needed information, of showing that it is not unwillingness to spend money, but the difficulty of overcoming the almost insuperable obstacles which stand in our way, that prevents our acceding to the popular demand; that we propose to deal with the problem, and are ready to adopt any feasible system.

This organization is one, I consider, of the greatest practical importance, and I trust that this committee, which has so energetically taken the matter in hand, will be enabled to solve all the problems, and give the public a complete and satisfactory system.

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[26] Benjamin Wilson. Elec. Expts. 1752.

[27] Birk's Matter and Ether. London, 1862.

[28] Grove, loc. cit., p. 6. W. Mattieu Williams. The Fuel of the Sun. Humboldt Library, No. 41. N. Y., 1883. Dr. C. W. Siemen's. Nineteenth Century for April, 1882.

[29] To the literature of this subject has recently been added a pamphlet, by Roald Arentz, entitled "The Nature of Electricity and Cosmic." Hartford, 1883.

Mr. W. M. Ivins spoke as follows:

The importance of this subject has not been overrated by Mr. Minturn. Its difficulties should be discussed with entire frankness, and the preliminary steps carefully considered. We are acting primarily for the benefit of twenty odd great corporations, and ultimately for the good of the entire public. Knowing, as we do, the feeling of our legislators and the public, the growing need of electrical communication, and the present condition of the streets, it becomes absolutely necessary that we now take decided, concerted, harmonious action through the most efficient committees we can select.

Representing, as we can fairly claim, the best scientific and practical opinions obtainable on electrical subjects, it is only fit that we should take this matter into our serious consideration, and by so doing, place ourselves in a position which will enable us to arrive at an immediate business conclusion.

Remarks were also made by Messrs. J. P. Davis, R. R. Hazard, A B. Chandler, T. J. Montgomery, and others.

This seems to be decidedly a step in the right direction, and we hope that good results will come from it.

While we think the agitation in regard to overhead wires is largely founded upon sentiment, it is, nevertheless, undoubtedly true, that many inconveniences result from the great number of wires which now encumber the streets; and we have no doubt that the companies will find it, in the end, greatly for their advantage, for reasons of economy, to place their wires underground. The subject, however, is an extremely complicated one, and sufficient time should be given to it to thoroughly test the different systems proposed, so that the best one may be selected.

OUR PARIS CORRESPONDENCE.

PARIS, April 8th, 1883.

THE French electrical companies do not seem inclined to attempt to introduce electrical illumination into private houses as the Edison company in New York have done. They do not feel encouraged to try such a costly experiment at a time when capital is becoming shy, and they prefer more remunerative, although less brilliant, operations. Amateurs of electricity, and especially inventors, do not despair, however, of being able to replace gas by incandescent lamps, and they are now directing their attention to the only two methods which do not require the employment of electro-motive power in dwellings, viz., electric accumulators and batteries.

I shall not discuss the question of accumulators at present; they are being carefully studied in France and England, but we must wait until time has confirmed the results obtained, and until a regular system of working shows the services that may really be expected.

The knowledge we have of the battery will allow us to be more precise. We must affirm, *à priori*, that the battery can only be used for costly illumination, and that the cost must be put out of the question altogether. Under these circumstances, we find several systems presented and which are novel with regard to their details, if not with respect to principles.

The Comptoir d'Escompte, in Paris, uses the electric light on a large scale by means of a Tarriant bi-chromate of soda battery; it is very ingeniously arranged, but it is very expensive to work, and not adapted for small spaces.

M. Gaston Tissandier, the estimable manager of *La Nature*, has also made a very good modification of the ordinary bi-chromate of potash battery, so that by regulating the size of the zincs and carbons and adding chromic acid, the polarization is retarded, and the element is regular and constant for three hours. This kind of battery would be the most suitable for lighting dwellings, as there are no dangerous or disagreeable emanations. When bi-chromate of potash becomes 50 per cent. cheaper, as it is very likely it will, the battery will not be too expensive.

The chloride of silver battery, which has been hitherto confined to laboratories, is the object of two patents that have been recently taken out. One of the patents is taken by Mr. Mackenzie; the other by M. Scrivanow. It is difficult to see any difference between them, except in the mounting. A small company has been formed to work the Scrivanow patent, but we very much doubt that results will be equal to the hopes of the financiers, although some surprising experiments were made. By using chloride of silver, from 150,000 to 200,000 kilogrammetres may be stored in a relatively small and light element, but the high cost of the salt puts it beyond popular reach. It requires to have a regular passion for electricity to purchase batteries at 200 francs per kilogramme, not to speak of having to use baths of *aqua regis*, or of chloro-chromate of potassium dissolved in sulphuric or nitric acid. The chloride of silver battery may be suitable for medical purposes. M. Gaiffe has made a very serviceable model—or for electrical lighters for gas—as made by Mr. Boyd, of Lynn (Cheshire), by combining it with an induction coil; but we do not believe that it can be used (except in some special cases), for domestic purposes.

However great may be our wish to see electricity substituted for gas, it will take a long time before it can be realized. One of the greatest obstacles to be overcome, is the necessity of having a motor for driving the dynamo-electric machine; in addition to the trouble it gives—the expenses being distributed only over a small number of lights and for a limited time—there cannot be any economy in the use of the light. Neither must it be forgotten that the gas fixtures cannot be utilized, and thus we have another material loss. On account of all these reasons it can be understood how the electric light can only be used for the present in workshops, stores, and establishments where large spaces have to be lighted up. Some details of the putting up the Jablochkoff candles in places in Paris or the neighborhood, will give the best illustration of this. Few persons, even in Paris, are aware that there are now nearly 1,000 lights of this system in working order; some of them were put up four years ago, and a list of them will be the best evidence of the advantages of the electric light:

Parc Monceaux. The city of Paris purchased and put up at its own expense the necessary apparatus for 16 lamps, 12 of which have been lighted every evening for five months past. There are two of Gramme's auto-conducting machines worked by a half stationary engine.

Magasin and Hotel du Louvre. Sixteen lamps were first put up in 1879, and the number was successively raised to 80 and 150.

Magasin du Printemps. The temporary fitting up includes 140 lamps; the number will soon be 164, and will be eventually 400.

Grand Opera. Seventy-two lights have been put up in the dome to illuminate the painting of the ceiling on gala and ball nights. Three of Gramme's machines are used.

Grand Hotel. Sixty lights, fed by three Gramme machines, are used for the reception, dining, and reading rooms, and for the principal court.

Hotel Continental. The court, dining room, and Moorish hall, as well as the entrances, are lighted up by 32 lights, fed by two Gramme machines.

Hippodrome. Nine Gramme machines of 20 lights—one of them auxiliary—are used here, besides 140 Jablochkoff candles. There are used, in addition, 28 regulators, fed by 28 Gramme machines (workshop type), for lighting the track. The motive power is supplied by two steam engines, each of 100 horse-power.

The whole of these establishments are provided with 606 lights, to which those of the following establishments must be added: Palace Theatre, 28 lights; Theatre du Chatelet, 16; Christofle (silverware), 6; Lemaire (optician), 4; M. Menier (private residence), 4; M. Menier (stables), 12; Crespin (building yard), 6; Corpet (machine shop), 24; Weyher & Richemond (steam engines), 6; Lecouteux & Garnier (steam engines), 6; Farcot (steam engines), 8; Batignolle Building Co., 20; Baudet, Donon & Co. (metal architectural work), 40; Escaude (metal architectural work), 6; Perin, Pauliard & Co. (machinists), 16; Jaeggi & Perard (machinists), 8; Solier & Co. (locks), 6; Rousin (cabinet manufacture), 4; Samuel (cars and wagons), 24; Comp. Gen'l des Petites Voitures), 8; Conservatoire des Arts et Metiers, 4; Rattier (electric cables), 32; Chantiers et Ateliers de la Seine, 8; Comp. de Materiel de Chemin de Fer, 20; Ivry Forges, 16; Durenne (copper works), 16; Lamy (manufacturer), 6; Raynaud, Séchade, Gui & Co. (Ivry), 20.

We thus come up to a total of 980 lights, without taking into account the temporary fittings that were made during the holidays; the lighting of the exhibition of paintings; the public works, etc. It may be concluded from this, that the primitive type of the Jablochkoff candle is, despite the so-called improvements of M. Jamin and others, more than ever appreciated. The absence of any mechanism, and the care given to its manufacture, justify the preference given to it by consumers of electric light.

It is proper to observe, that the complicated mechanism of regulators has contributed, to a certain extent, in restricting the industrial application of electricity. The slightest accident to the apparatus necessitated its being sent to the manufacturer; thus a double plant was required. The Jablochkoff candle possesses a marked superiority in this respect; and, which is only fair to recognize also in the incandescent lamp—and this is, perhaps, their best recommendation of the latter, which, in so far as cost is concerned, has a hard struggle with gas.

However, some factories in France have been lighted up with the incandescent lamps. A car factory at Saint Denis, near Paris, is lighted with the Maxim lamps, and accumulators are used. A more extensive trial has just been made in the workshops of Lá Buire, no fewer than 400 lamps being used. The cost per hour per lamp of two Carcel burners is about four centimes. The redemption and interest of the cost of fitting up, represents only one-half of their cost price.

There is a movement at present to replace gas by electricity in the Paris Grand Opera. Proposals have been made to the electric companies, and it is possible that the Edison company may be tempted to repeat the successful experiments that it had with the theatres of Brunn (Moravia), and Brussels. The undertaking would be quite an important one, as several thousand lamps would be required, and the first cost of fitting up—including apparatus, motive power, dynamos, and especially the cost of an engine room —would amount to two or three million francs. It is true that this would give the means of extending the electrical canalization to a number of houses, and distributing force and light in one of the richest quarters in Paris. The matter is at present only under discussion, but we have every hope of seeing the plan adopted.

We have a few words to say about the experiments made by M. Marcel Deprez in the electrical transmission of force in the shops of the Chemin de fer du Nord (Paris). According to the report presented to the Academy of Sciences by M. Tresca, formerly sub-director of the Conservatoire des Arts et Metiers, the product would not exceed 33 per cent.; that is to say, the utilizable power, measured on the break on shaft of the receiving machine, does not exceed one-third of the motive work, measured by the dynamometer. Such a result will only surprise those who judge of the power of a machine from theoretical formula. M. Deprez promised us, some eight months ago, by virtue of fundamental laws and equations, that he would have a return of 65 per cent. at a distance of 50 kilometres. He has only yet succeeded in keeping one half of his promise, and this without going further than eight kilometres. His experiments are none the less remarkable from a purely scientific point of view. They will be very valuable for his followers in this line, and will furnish *savants* with opportunities for interesting experiments on the phenomena which take place in electrical machines while working.

It appears from the observations of M. Tresca, that a loss of work takes place both on the generator and the receiver, and that it is unaccountable, and that it represents for an average work of 10.39 horses, 0.84 horse-power on the generator, and 1.30 horse on the receiver, or, altogether, 2.14 horse, or 21.5 per cent. of the motive work. A learned electrician, M. Joubert, has attributed the losses to self-induction, but we believe that this explanation requires further developing before it can be accepted. However, this is a fine subject for discussion, and lovers of calculations can find scope for their talent.

In a word, the experiments of M. Marcel Deprez have drawn public attention to the problem of the electric transmission of power, but without giving any satisfactory solution for industrial purposes.

PH. DELAHAYE.

(Contribution from the Laboratory of the Cooper Union, No. 1.)

THE APPLICATION OF ELECTRO-CHEMISTRY TO THE MEASUREMENT OF ELECTRIC CURRENTS.

BY GEORGE G. GROWER.

IF an electric current is passed through a solution, called an electrolyte, the solution is decomposed, the positive constituent (generally a metal) is carried to the negative electrode, and the negative (generally an acid radical) is carried to the positive electrode.

If the electrolyte is a solution of a metallic salt, and the electrodes are plates of the same metal, then the negative electrode receives a deposit of metal, and the positive loses an equal amount, because the acid liberated at it, dissolves the same weight of metal with which it was originally combined. The solution remains unchanged.

The same current always carries over the same weight of the same metal, but if the metal be changed the deposit is also changed. It is directly proportional to the chemical equivalents, that is, the atomic weight divided by the valency, thus: if a current is passed through a solution of silver, zinc and copper, for every 108 parts of silver deposited 31.5 of copper, and 32.5 of zinc will also be deposited.

The practical unit of current, called an "ampére" will carry over .0104 milligrams of hydrogen for each second that it acts. To find the deposit of any metal (in milligrams) by 1 ampére-second, all that is necessary is to multiply the chemical equivalent by .0104.

This principle is practically used in the measurement of electric currents, as follows:

The metal generally used is copper, and the solution is copper sulphate; the gain in milligrams is divided by .329, and this gives the number of ampére-seconds. The fraction .329 is the weight of copper which 1 ampére deposits in one second.

Several other metals may be used with more or less accurate results, but for very small currents, especially if working on shunts, even copper does not work well; the only metal which can, for such currents, is zinc, and it has to be amalgamated.

The "Edison" meter, which is the only electro-chemical meter of any practical importance, is constructed on the following principles.

A small portion of the current is passed through a bottle containing two amalgamated zinc plates, and a solution of zinc sulphate. The current deposits zinc on one plate, and removes it from the other. Either the gain or loss could be taken, but the loss is preferred in practice. It is found to be more regular than the gain, because the deposit on the gain plate is not very adherent, and is easily shaken off, so that during weighing, if the deposit were used, there would be danger of error from its accidental loss.

The fraction of the whole current, which passes through the bottle is constant, and is determined by the relative resistance of the bottle and shunt. As the resistance of the solution is different at different temperatures, it is necessary to put a spool of copper wire in series with the bottle, so that when the resistance of the bottle diminishes by an increased temperature, the wire increases the same amount, thus keeping the whole resistance (and, therefore, the fraction of the current through the bottle) constant.

To prevent the solution from freezing, when the temperature is low enough, an Edison lamp is placed in the meter, which lights when the temperature falls to 40° Fahr., and goes out when it gets above that temperature. This is effected by a thermal spring, made of a strip of brass and a strip of steel riveted together.

The brass expands and contracts more than the steel by changes in temperature. This causes the spring to bend more or less, and at the set temperature it makes contact between two platinum points and lights the lamp.

PUBLIC ELECTRIC LIGHTING.

A RECENT number of *Nature* referring to the operation of the Electric Lighting Act, passed during the last session of the English parliament, says: Under the terms of that Act, licenses and provisional orders will be granted to local authorities, companies, and private individuals to supply electricity for the purpose of electric lighting over definite areas. A large number of applications for licenses and provisional orders have already been submitted to the board of trade, in a few instances by local authorities, but in the majority of cases by joint stock companies, formed for working one or other of the different systems for electric lighting. A number of the "provisional orders" now being promoted lie before us, the majority of them being drawn in almost identical terms. A perusal of these documents cannot fail to impress the reader, firstly, with the great complexity of the question; secondly, with the extreme difficulty of striking a fair balance between vested interests and public convenience; thirdly, with the great amount of knowledge and skill displayed in the drafting of these provisional orders. It is an open secret that not only the main outlines but also most of the details of these orders are from the hand of Mr. J. Fletcher Moulton, F.R.S., whom we must congratulate upon the success with which he has applied himself to the task of preparing them. Now that parliament is once more in session we shall probably hear of further legislative proposals; but if all provisional orders are as well and as wisely drawn as the majority of those before us appear to be, there can be little doubt that the necessity for separate further legislation, and for the promotion of private bills for electric lighting will be removed.

As to the provisional orders themselves, it would be impossible within reasonable limits to deal with a tithe of the important topics which are therein set forth. Many of the provisions are naturally directed toward questions of municipal rights and parochial law. Leaving aside all these matters we come to the more scientific points. Four separate systems of distribution are recognized in the provisional orders. These are (*a*) "direct" system, more familiar under the name of distribution in parallel arc, with "distributing mains" throwing off "service lines" for individual consumers; (*b*) "storage" system, with service lines in parallel arc from storage batteries charged in series intermittently from a generating station; (*c*) either of the above with "earth" returns; (*d*) "series" system, supplying customers in one undivided circuit. We may remark, in passing, that it appears to us that the use of "earth" for return should be in every case forbidden. If currents of the intensity employed for electric lighting are sent through earth in our crowded cities, we shall have constant derangements of telegraphs, telephones, electric bells—in fact of all electric appliances which work by feeble currents and use earth returns. Moreover, as "earth" in practice means usually the employment of existing gas pipes or water pipes as returns, the proposal to utilize "earth" for electric light returns, is doubly to be deprecated. Amongst other limitations set forth in the provisional orders are some which bind the "undertakers" to lay down their mains within two years, some which prescribe the hours during which the supply of currents must be maintained, and some which limit the conditions of supply. Amongst the latter we observe, in several of the orders before us, that it is proposed that "the potential at corresponding points of the positive and negative distributing mains shall differ at each point by a constant difference, not being less than thirty volts, and not being more than four hundred volts." And that "such constant difference of potential" is to be termed "the standard pressure." It is to be hoped that the board of trade will be much more precise in its limitations. Thirty volts is so low a "pressure" as to be practically out of the question except with a gigantic outlay in copper conductors, whilst four hundred volts is equally inadmissible on account of the danger to person. No less an authority than Sir W. Thomson has said, that nothing above two hundred volts should ever be admitted into a dwelling house. The provision, that "the standard pressure may be different for different points of the said mains, and for different hours during the period of supply" is bad, and if permitted will greatly militate against convenience and uniformity in using the current both for light and for motive power. Where the undertakers distribute "alternating" currents it is provided that the mains should have a "constant (?) difference of potential," or standard pressure of not less than forty-five and not more than six hundred volts. Here again we think that the board of trade might very wisely insist on a further restriction. If steady currents at a pressure of four hundred volts are dangerous, alternating currents at four hundred are far more so. Yet, here the undertakers talk of six hundred! Indeed, considering the risks involved, and the difficulty in distributing alternating currents through long lines or lines where there is great self-induction; and also considering that the supply of electric currents is not for lighting alone, but for the providing also of motive power, it would not be any loss to the public if the use of alternating currents under the provisional orders were absolutely disallowed. It is true that the patentees of certain specific forms of machine might cry out loudly against such a prohibition; but the public would be guaranteed against one source of danger and difficulty. According to the orders, the undertakers may charge consumers either by the amount of electric energy consumed, or by the quantity of electricity supplied, or by time, or by a yearly agreement. In connection with the first of these methods, the proposal is made to call by the name "one unit," the energy contained in a current of 1000 ampéres, flowing under an electro-motive force of one volt during one hour. Most of the provisional orders name sevenpence per unit as the price of electrical energy. We have here, for the first time, an actual quotation price for *energy*; a fact which should be interesting to those who have striven so hard to drive into the popular mind exact ideas concerning energy and its conservation. One "unit" thus defined for commercial purposes being 1000 volt-ampéres (*i.e.* 1000 watts) for one hour, and one horse-power being 746 watts, we see that the scale of payment is about 5⅓ pence per hour per (electrical) horse-power.

Into the further provisions for the inspection and testing of mains, the inspection of meters, the testing of insulation, provisions for safety, and penalties for default in supply, we cannot here enter. Suffice it to say that there is no detail that does not appear to have had thought expended upon it, no provision that is really superfluous or harassing, no possible want or eventuality that does not appear to have been anticipated. Such masterly treatment cannot but greatly facilitate the work of the board of trade in agreeing to orders and licenses, and will tend to bring about unity of method in the organization of the actual work of laying down town supplies so soon as such orders and licenses shall have been granted, If it be true that the effect of the Electric Lighting Act has been to produce a temporary lull in the progress of electric lighting, we are convinced that such a lull will be in the end an unmixed good, since it gives the opportunity for thought to ripen, and for projects and inventions to mature, if not to survive. Two dangers indeed seem yet possible in the future of public electric lighting, and either of them may be sufficiently serious to damage public confidence in this new industrial factor. Firstly, some better guarantees ought to be insisted on that the companies or other parties who obtain orders or licenses, as undertakers, should be possessed of capital adequate to carry out the projects in hand. A very hasty glance at the list of applicants for provisional orders will suffice to show that this fear is not unfounded. Secondly, it ought to be made impossible for a company which has obtained an order for any limited district to delegate the responsibility of supplying any section of such district to a sub-company. No company should be allowed to hold a monopoly (if the limited monopoly created by the provisions of the Electric Lighting Act be a monopoly at all,) of a single square yard of territory which it cannot with its own resources supply under the terms of the order or license which has been granted. If this principle be not upheld, serious abuses will creep in, to the detriment of progress and in contravention of the interests of the public.

SPARKS.

—— ON THE 21st of every month there is a dinner at the Café Durand, in Paris, of French electricians.

—— THE BOARD OF CITY TRUSTS of Philadelphia, acting for the Girard estate, propose to illuminate a part of Delaware avenue.

—— THE DAYTON ELECTRIC LIGHT COMPANY have lately ordered an additional installation of one hundred and twenty of the standard lights of the Fuller Electrical Company, for use in connection with the large plant already in operation in that city of South-Western Ohio

—— THE FULLER ELECTRICAL COMPANY have lately applied to the Common Council of the city of Brooklyn, for permission to establish a system of general illumination for the streets, stores, and other business buildings throughout all the principal streets of that city.

—— THE SEVENTEENTH BULLETIN of the Edison Company reports many recent important plants of the company, viz.: Village lighting at Roselle, New Jersey; New York *Commercial Advertiser* office; Dakota apartment building; village plant at Brockton, Mass., as also many others.

—— A VIENNA PAPER says that the electric light has been introduced in the wards and operating room of the General Infirmary in that city. There is a portable as well as a fixed lamp in each ward. The accumulator system obviates the necessity of the dynamo working at night, but it states that it is too expensive for general adoption.

—— AT THE ANNUAL conversazione of the French Physical Society, M. Trouvé exhibited some of his new bi-chromate batteries at work; and at a reception recently given by the manager of the Société Edison, each lady dancer was presented with a bouquet, in the middle of which shone a tiny Edison lamp, fed by a battery devised by M. Trouvé.

—— ACCORDING TO THE RECENT experiments of M. G Foussereau, the electric resistance of glass diminishes considerably on being tempered. On the other hand, annealing tempered glass restores its higher resistance. The same may be said of tempered crystal. The resistance of glass tempered, or contempered, provided the glass is not unduly heated, is found to remain constant.

The Aëronaut publishes an article from M. Napoli, electrician to the Great Eastern Railway of France, showing that electricity supplies a less ponderous motive power than steam for propelling balloons. He supposes that 3,230 grammes of material is enough to generate, by means of Bunsen elements, an electric current able to give with a Gramme machine of a convenient construction, one horse-power working during an hour.

—— IT IS STATED by the foreign papers, that at a large number of private and official *soirées* in Paris this winter, the electric light has been used from storage batteries in a very simple manner. The accumulators are carried in a vehicle which is stationed in front of the house, and electric wires are conducted into the building through the windows. Incandescent lamps are placed in the ordinary candelabras, and the fitting of the most complex lighting is an affair of a very few hours.

—— THE *Evening Telegram*, says: A new time ball similar to the one on the Western Union building, New York city, has been erected on the new Packer building at Mauch Chunk, Pa., by the Lehigh Valley Railroad Company. The ball is connected by wire, at noon daily, with Mr. James Hamblet's clock in the Western Union building, New York, and is dropped by a signal sent at 12h. 5m. New York time, which is precisely noon of Philadelphia time, the latter being the standard time for the Lehigh Valley Railroad Company.

—— FOR A MAN of muscle, a prodigious negro in Providence is the ablest man in Rhode Island. He is retained as an expert by an express company, in lifting casks, and fighting the law of gravity, generally. Recently, when in the gymnasium attached to a club room, he was challenged to exhibit his strength, and first drew himself up by rings hanging from the ceiling. These rings formed the terminals of an electric battery, and when he had raised himself, the circuit was closed—contracting the muscles so that he could not lower himself to the floor. When the current was switched off, he left, saying that he did not wish any more gymnastics.

—— ABOUT THE FIRST OF JANUARY, some of the large clothing houses at Newark discontinued the use of the electric light, which had been furnished to them from the Weston lighting station, in that city, on the ground that, at the prices charged, the electric light was more expensive than gas. Although the gas company has furnished them with gas at exceptionally low rates, several of them have recently put in the electric light again, having found gaslight very unsatisfactory, both to themselves and to their customers, after their experience with the electric light. The other clothing firms will, probably, follow their example. No reduction, as we understand, has been made in the prices charged by the electric light company.

—— A LONDON PAPER states, that Dr John Hopkinson delivered a lecture last week before the Institution of Civil Engineers, "On some Points in Electric Lighting," in which, after dealing with several theoretical points, he said that, at present, lighting by electricity in London must cost something more than lighting by gas. The electrician could not look for much advance in the economy of the engine and boiler, and dynamos are already so good, that there is not much chance of greater efficiency being found in them, though their prime cost will soon be greatly reduced. His hope of obtaining greater economy is based upon possible improvements of incandescence lamps. It has been shown, that by working the lamps at high pressure, a marked economy of power can be obtained; but then, they soon break down. In ordinary practice, for instance, from 140 to 200 candles can be obtained per horse-power actually put into the lamps; but he has seen as much as 1,000 candles produced by one-horse power—only that was for a short time, as the filaments soon break down. The problem, then, is to improve the lamps, so that they will last a reasonable time when pressed to their highest efficiency, and Dr. Hopkinson evidently thinks that will be done.

—— A WASHINGTON DESPATCH, of April 11th, says: The Bell Telephone Company has commenced an agitation which will scarcely have the result that the company desires, as it will be very likely to open the question of the patent laws in the next Congress, and possibly may secure the enactment of a statute which will provide that the United States Government shall be entitled, at all times, to make use of any patents without charge It seems that the United States signal office has a man in its employ, Sergeant Eccard, who has invented a very useful telephone, and who has combined his receiver with the Gray, Phelps, and Edison transmitter. The result of this peculiar combination is to obtain a very much stronger telephone than the Bell; one which is adapted to harder work, and which is less liable to get out of adjustment The signal service officers claim, that while the Eccard combination is adapted to certain special service, the Bell telephone is not adapted to it at all; but the Bell company proposes to insist, not only that the Government shall not use this combination, but that it shall destroy all telephones which are not of the Bell patent. The subject is to be referred to the Attorney-General. Various attempts have been made at different times to enact a law which should provide that the Government, in consideration of granting a patent, should have the right to the use of patents. The Bell company has probably furnished the text for a general discussion of this whole subject in the next Congress.

—— MR. C J. H. WOODBURY, of Boston, read before the Franklin Institute, at Philadelphia, on the evening of the 18th of April, an interesting paper on "Portable Electric Testing Apparatus." In referring to the fire risk by electric lighting he said: "It is not necessary at this time to recount any of the fires caused by electric lighting, but I am not aware of a single fire of this nature, which, in the light of present knowledge upon the subject, is not to be considered as a preventable fire. With proper and *continual* attention to insulation, construction of lamps and of switches, and in the incandescent system also, the proper size of conducting wires and *closed* safety catches, there can be so little opportunity for fire from electric lights that, under these conditions, it forms the safest method of illumination.

Most of the fires and other difficulties with electric lighting apparatus have been caused by the diversion of the current from the system at distant points, each leading to the earth, and very few accidents due to a conductor making a cross between two adjacent wires. Two contacts are required in order to form the complete circuit necessary to establish an electric current. If a single conductor leads to the earth, only a second one is necessary to divert a portion of the current from the system to the earth, the relative quantities of the current seeking the two paths, being inversely proportional to their electrical resistances of the conductors." Mr. Woodbury exhibited a portable instrument* for the purpose of electric testing, designed by himself, and which seems to have much merit. It requires no electrical skill for its use, is not affected by time or temperature, can be used in any position, and has stood the test of over a year's constant use, without accident or deterioration of any nature.

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* For illustration and description of this apparatus, see ELECTRICIAN, Vol. I., page 204.

—— M. TROUVÉ IS STATED to have considerably improved the bi-chromate battery in the matter of permanency, by super-saturating the liquid. He takes 150 grammes of bi-chromate of potash powder to a litre of water, and after shaking, adds, drop by drop, 450 grammes of sulphuric acid. The liquid warms and the salt dissolves, while no crystals are formed on cooling, nor are chrome alum crystals deposited in the cell. The elements are arranged with two carbons to each zinc, the latter being so placed that it can be withdrawn from the solution. With twelve elements and the solution above described, it is stated that ten incandescent lamps can be kept at work for five hours, each lamp going ten candles. The E. M. F. of the cell is stated to be 2 volts with fresh solution.

—— *Nature* SAYS: It is undoubted that Gramme was the first to construct a dynamo-electric machine with continuous induction, using (independently of Pacinotti) a ring-armature, similar to Pacinotti's ring. But regarding the question, who it was that first produced continuous dynamo-electric currents, and so was the first to combine, experimentally, the principles of Siemens and Pacinotti, Prof. von Waltenhofen offers proof (*Wied. Ann*, No. 2) that this priority belongs to Prof Pfaundler of Innsbruck. In 1867, Herr Kravogl, of Innsbruck, showed his electromagnetic motor at the Paris exhibition; this consists of coils forming a hollow ring which rotates round a horizontal axis, while it incloses a bent cylindrical rod, tending by weight to take the lowest position, but kept suspended in a certain raised position by currents in the coils, whereby also the ring is rotated In a letter on this machine, in 1867, Prof. Pfaundler proposed to apply Siemens's principle to it, and get electric currents from mechanical work of rotation (the battery being included at first with a shunt, then quite excluded). This he tried and effected about three years later, as a letter dated February 11th, 1870, records. Thus Pfaundler seems to have produced continuous dynamo-electric currents before Gramme, and to have indicated the possibility of getting such currents from the Kravogl ring machine in the same year (1867) as Siemen's invention of dynamo-electric machines acquired publicity.

BUSINESS NOTICES.

WANTED—A clean copy of THE ELECTRICIAN, of August, 1882, for which fifty cents will be paid. Address, W. J. JENKS, Brockton, Mass.

ONE of the Commissioners of the Franklin Institute to the Vienna International Electrical Exhibition, will take charge of American exhibits, and correspond for a few American papers while in Vienna

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BOOK NOTICES.

MISCELLANEOUS, LITERARY, SCIENTIFIC, AND HISTORICAL NOTES, QUERIES AND ANSWERS, FOR TEACHERS, PUPILS, AND PRACTICAL AND PROFESSIONAL MEN. N. B. Webster, Editor. J. C. and L. M. Gould, Publishers, Manchester, N. H. A 16 page monthly. Price, $1 a year, in advance.

ELECTRO-MAGNETS; The determination of the elements of their construction. Translated from 2d edition; T. Moncel

D VAN NOSTRAND, 23 Murray Street, New York.

THE MODERN SERVICE OF COMMERCIAL AND RAILWAY TELEGRAPHY, by J. P. Abernethy, Superintendent Telegraph, Cleveland, Ohio. 2d edition. 318 pp. 12mo. Published by the author.

This volume forms a valuable contribution to the subject of the practical operation of the telegraph. It is addressed directly to the needs of operators, and those directly connected with the practical management of telegraph systems, and treats of the fundamental principles of the subject, without digressing into any hypothesis and mathematical formulae of electricity, which would hardly be germane to the scope of the book. Matters which come to every one connected with the telegraph, in a practical way, are printed as a question, in italics, so as to enable the reader to fix upon the subject matter which he seeks. It is written in a clear style, and is of value to every one connected with electrical matters.

BERLY'S ELECTRICAL DIRECTORY FOR 1883—Published by W. Dawson & Son, London.—This, the second annual issue, is a most important improvement, and seems to foreshadow, in many ways, the "growing growth" of the electrical industry England, the United States, Canada, France, Germany, Russia, and Belgium, have furnished the copious lists contained in the 670 pages of the volume. The work is well printed on good, calendered paper (so seldom used by transatlantic publishers, except for works *de luxe*), and is strongly and tastefully bound in cloth. Several useful tables and formulæ, relating to telegraphy, electric units electro-motive force, &c., are given, which will add to the practical merits of the work. It might be objected that there are too many of the "classified trades" represented, but as the publisher says: "The public have answered this question themselves, by contracting specially to have some of the more indirect trades brought under the notice of the large electrical trading companies and electricians." While so many trades and industries are seeking the custom of electricians, the latter, too, will be glad to have the addresses of the best makers and furnishers of the manifold materials they require in their industry. A directory is essentially a book of changes, and thus, like an almanac, becomes of less use as it grows older, so that many errors are inseparable from such a work as the present. Mailed, registered, on receipt of $2.60. Address, CUMMING & BRINKERHOFF, 219 East 18th Street, N Y.

THE ELECTRIC LIGHT IN SURGICAL DIAGNOSIS, by Roswell Park, A. M., M. D., President of the Chicago Electrical Society, etc., 22 pp. 8vo. Chicago.

By the same,

SECONDARY BATTERIES; AND THE SO-CALLED STORAGE OF ELECTRICITY. 16 pp 8vo. Reprinted from the *Chicago Medical Journal and Examiner*.

Not many years ago, electricity was brought to the fore, as the coming element in medical science. Unfortunately, it fell into hands incompetent for the work, and it was proclaimed as a panacea, for all the ills that flesh is heir to. Changes were rung upon old proverbs; "throw physic to the dogs, electricity is life," and other half truths were announced as facts. The revulsion of feelings, in the skilled members of the medical profession, and the broad common sense of the more intelligent portion of the community, against such extreme, and untenable grounds, resulted in giving a set-back to the legitimate uses of electricity in human disease.

Some of the later forms of secondary batteries, and incandescent lamps, afford the medical profession with new methods, and increased means, in diagnosis and operation.

Dr. Park presents a clear description of the apparatus made by Leiter (of Vienna), for the purpose of illuminating the interior of the body, by incandescent lights. Instruments for lighting the interior of the throat, œsophagus, stomach and bladder, are shown.

They consist of modifications of specula with a platinum coil at the end, which is kept at a state of incandescence by an electric current, from a Faure secondary battery. The circulation of water, in a water jacket around the platinum, prevents any injury from the heat from the platinum. Only three sets of these instruments have ever been sent to this country; and their expense, as well as the special training necessary for their operation will probably restrict their use for the present to large hospitals

In using platinum coils, it does not seem as if Leiter availed himself of the latest state of the art of incandescence lighting. A carbon filament in vacuo, would certainly give more light, when a given quantity of heat was radiated from the lamp. In a paper, recently read by Dr. T. Oliver, before the Northumberland and Durham Medical Society, an interesting description was given of the use of a small Swan incandescent lamp "about the size of a bean" which gave two candle power when fed by two cells of grove battery. He was able to see the interior of a cyst in the liver, by inserting the lamp and speculum in an incision made for the purpose.

These uses of electricity are full of promise, alike to surgeons and to electrical inventors.

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PATENTS FOR MARCH AND APRIL, 1883.

MARCH 27th.

274,573 Bell, Electric. C. F. De Redon, Paris, France.
274,562 Cables or Conductors, Suspending. C. E. Chinnock, Brooklyn, N. Y.
274,865 Electric Generator. S. J. Wallace, Keokuk, Iowa.
274,611 Electric Wires, Conduit for. W. H. Johnstone, Philadelphia, Pa.
274,699 Electrical Conductor. G. F. Barker, Philadelphia, Pa.
274,845 Insulated Wire for Electrical Purposes. T. H. Thompson, Waterbury, Conn.
274,622 Insulating Compound for Electrical Wires. J. F. Martin, Chicago, Ill.
274,821 Insulator, Electric Wire. W. H. Reiff, Philadelphia, Pa.
10,299 Lamp Bracket, Incandescent (Re-issue). E. Weston, Newark N. J.
274,744 Lamp, Electric-arc. J. Du Shane, South Bend, Ind.
274,654 Lamp, Incandescent Electric. C. G. Perkins, Camden, N. J.
274,653 Lamp Switch, Incandescent Electric. C. G. Perkins, Camden, N. J.
274,564 Lightning Conductor. J. H. Coon, Des Moines, Iowa.
274,802 Secondary Battery. A. J. Martin, Catskill, N. Y.
274,710 Telegraph or Telephone Lines, Conduit for. S. Brentano, New York, N. Y.
274,665 Telegraph, Printing. G. B. Scott, Brooklyn, N. Y.
274,748 Telegraph, Printing. S. D. Field, New York, N. Y.
274,522 Telegraph Wire Conduit, Underground. A. Sloan, Newark, N. J.
274,652 Telegraphy Apparatus, Electric. P. E. Derez, New York, N. Y.
274,577 Telephone. T. A. Edison, Menlo Park, N. J.
274,552 Telephone Call Circuits, Pole Changer for. E. E. Bawsel, Washington, D. C.
274,602 Telephone Exchange Circuit. A. S. Hibbard, Milwaukee, Wis.
274,857 Telephone Exchange Signaling Circuit and Apparatus. T.N.Vail, Boston, Mass.
274,576 Telephone, Transmitting. T. A. Edison, Menlo Park, N. J.

APRIL 3rd.

2.4,904 Carbon Rod or Stick, and mechanism for making the same. C. F. Brush, Cleveland, Ohio.
275,179 Electric Elevator. S. D. Field, New York, N. Y.
275,289 Electric Light Circuits, Safety Self-closing Shunt Switch for. E. Thomson, New Britain, Conn.
275,290 Electric Light Circuits, Safety Self-closing Shunt Switch for. E. Thomson, New Britain, Conn.
275,169 Electric Machines, Armature for Dynamo. E. A. Edwards, Cincinnati, Ohio.
275,006 Electric Signaling Apparatus, Automatic. F. B. Wood, New York, N. Y.
275,028 Electric Wires, Underground Conduit for. H. Clay, Philadelphia, Pa.
274,916 Lamp, Electric-arc. J. A. Dalzell, New York, N. Y.
275,168 Lamp, Electric-arc. E. A. Edwards, Cincinnati, Ohio.
275,170 Lamp, Electric arc. E. A. Edwards, Cincinnati, Ohio.
275,171 Lamp, Electric-arc. E. A. Edwards, Cincinnati, Ohio.
275,172 Lamp, Electric arc. E. A. Edwards, Cincinnati, Ohio.
275,173 Lamp, Electric-arc. E. A. Edwards, Cincinnati, Ohio.
275,174 Lamp, Electric-arc. E. A. Edwards, Cincinnati, Ohio.
275,182 Lamp, Electric arc. J. R. Finney, Pittsburg, Pa.
275,183 Lamp, Electric-arc. J. R. Finney, Pittsburg, Pa.
274,997 Lamp, Electric-arc. S. F. Van Choate, New York, N. Y.
274,999 Lamp, Electric-arc. F. G. Waterhouse, Sacramento, Cal.
274,959 Lamp Globe, Electric. G. J. Murdock, Binghamton, N. Y.
275,237 Magneto-electric Machine. S. Marcus, Vienna, Austria-Hungary.
275,255 Railway Signal, Electric. H. C. Nicholas, Mount Washington, Ohio.
275,180 Railway Track Circuits, Electrical Connector for. S. D. Field, New York, N. Y.
274,905 Secondary Battery Element. C. F. Brush, Cleveland, Ohio.
275,339 Telegraph, Automatic Printing. A. F. & F. B. Johnson, Brooklyn, N. Y.
275,334 Telegraph, Duplex. J. E. Fenn, Elizabeth, N. J.
275,185 Telegraphs, Polarized Relay for Quadruplex. G. W. Gardanier, Brooklyn, N. Y.
275,195 Telegraphic Conductors, Supporting and Preserving. J. H. Green, Brooklyn, N. Y.
275,181 Telegraphy, Receiving Instrument for Quadruplex. S. D. Field, New York, N. Y.
275,178 Telephone, Speaking. S. D. Field, New York, N. Y.
275,310 Telephone Transmitter. E. L. Wilson, Boston, Mass.
275,296 Telephone Circuits, Automatic Signaling Apparatus for. T. N. Vail, Boston, Mass.

APRIL 10th.

275,510 Electric-arc Light. G. J. Murdock, Binghamton, N. Y.
275,407 Electric Cable. W. J. Philips, and G. L. Kitson, Philadelphia, Pa.
275,424 Electric Cable. S. F. Shelbourne, New York, N. Y.
275,425 Electric Cable, Subterranean. S. F. Shelbourne, New York, N. Y.
275,408 Electric Cables, Machine for Manufacturing. W. J. Philips, and G. L. Kitson, Philadelphia, Pa.
275,748 Electric Conductor, Flexible. S. Bergmann, New York, N. Y.
275,749 Electric Light Fixtures, Connection for. S. Bergmann, New York, N. Y.
275,440 Electric Light Switch. T. G. Turner, New York, N. Y.
275,392 Electric Machine, Dynamo. V. E. Keegan, Boston, Mass.
275,549 Electric Machine, Dynamo. C. J. Van Depoele, Chicago, Ill.
275,600 Electric Signaling Apparatus. C. Cummings, Virginia City, Nevada.
275,776 Electrical Conductor, Underground. J. Kruesi, Brooklyn, N. Y.
275,347 Electrical Machine. Frictional. P. Atkinson, Chicago, Ill.
275,399 Electrical Wire Conduit. J. F. Martin, Chicago, Ill.
275,752 Fire Extinguisher and Alarm. C. E. Buell, New Haven, Conn.
275,422 Insulating Compound for Electric Conductors. S. F. Shelbourne, New York, N. Y.
275,423 Insulating Subterranean Electric Cables, Mold for. S. F. Shelbourne, New York, N. Y.
275,345 Lamp, Electric-arc. J. B. Allen, Springfield, Ill.
275,613 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
275,612 Lamps, Manufacture of Incandescing. T. A. Edison, Menlo Park, N. J.
275,730 Lamps, &c., Molding Bulbs for Incandescent Electric. A. Swan, Gateshead, County of Durham, England.
275,433 Telegraph Key. E. G. Stevens, Cleveland, Ohio.
275,362 Telephone Exchange Switch. G. W. Coy, Milford, Conn.
275,420 Telephones, Head-gear for Switchmen's. C. E. Scribner, Chicago, Ill.
275,611 Telephonic Transmitters, Adjustable Support for. W. H. Eckert, J. A. Seely, and E. A. Eckert, Cincinnati, Ohio.
275,387 Underground Conductor. R. M. Hunter, Philadelphia, Pa.

APRIL 17th.

276,133 Electric Light, Incandescent. T. L. Clingman, Asheville, N. C.
276,063 Electric Machine, Dynamo. W. Morava, Chicago, Ill.
275,842 Electric Motors, Speed Regulator and Reversing Device for. E. Molera, R. and J. C. Cebrian, San Francisco, Cal.
275,797 Galvanic Battery. W. A. Alexander, Mobile, Ala.
275,845 Galvanic Battery. J. B. Odell, Chicago, Ill.
276,138 Interlocking Switch and Signal, Electric. O. Gassett and I. Fisher Boston, Mass.
276,038 Railway Signal, Electric. S. C. Hendrickson, Brooklyn, N. Y.
276,021 Railway Signal, Electro-pneumatic. O. Gassett, Boston, Mass.
275,879 Railway Trains, Electric Signaling Apparatus for. G. M. Bedinger, Jr. Erlanger, Ky.
275,985 Secondary Battery. C. F. Brush, Cleveland, Ohio.
275,986 Secondary Battery. C. F. Brush, Cleveland, Ohio.
276,099 Storage or Secondary Battery. C. J. Van Depoele, Chicago, Ill.
275,859 Telegraph Cables. Apparatus for Covering. J. Robertson, Brooklyn, N. Y.
276,087 Telegraphic Relay. J. P. Smithers, Brooklyn, N. Y.
276,136 Telephone Lines. Electric Signaling Apparatus for. D. Drawbaugh, Eberly's Mill, Pa.
276,137 Telephone Transmitter. D. Drawbaugh, Eberly's Mill, Pa.

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Burnap, W. H., Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q., Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Edson's Speed & Pressure Recording & Alarm Gauges, for "Steam Dynamo-machines," indispensable for safety & economy, office 91 Liberty St., N.Y.

Fairman, James F., Telephone, Telegraph, and Electric Light Supplies, and apparatus, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C., Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 43 Centre Street, New York.

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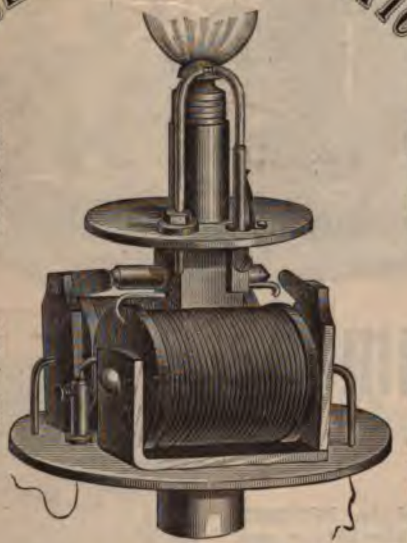

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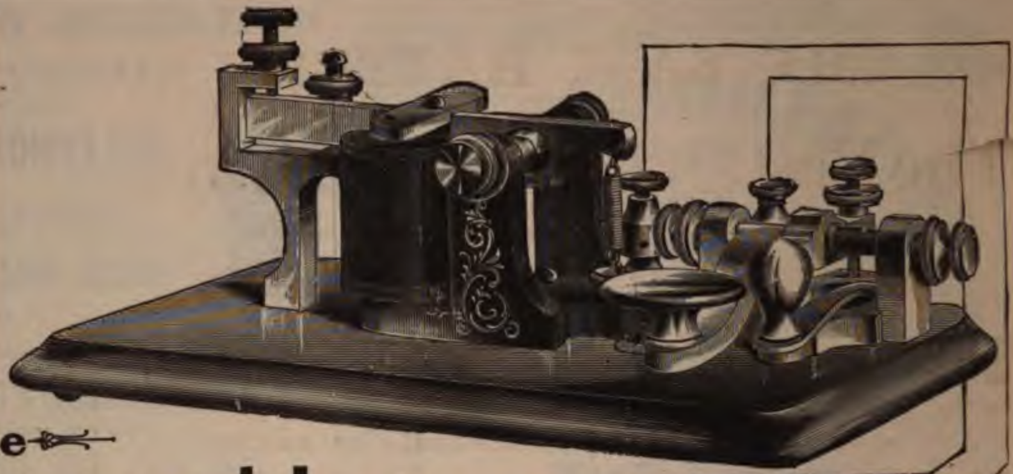

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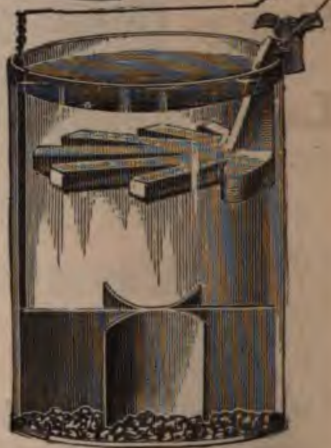

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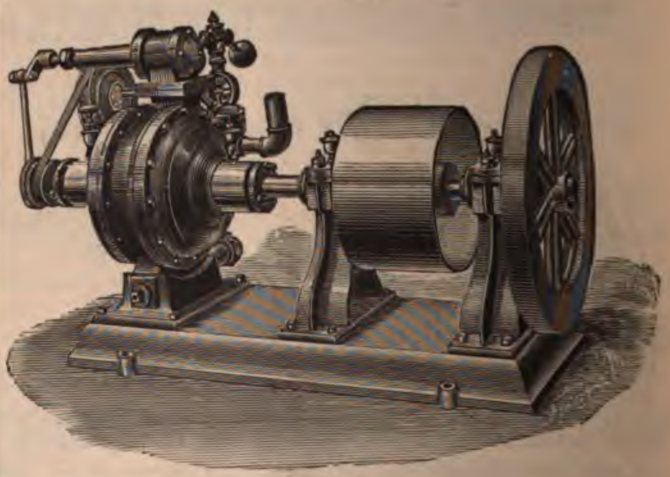

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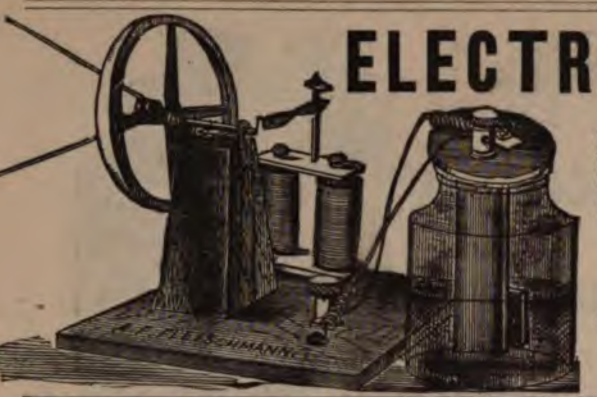

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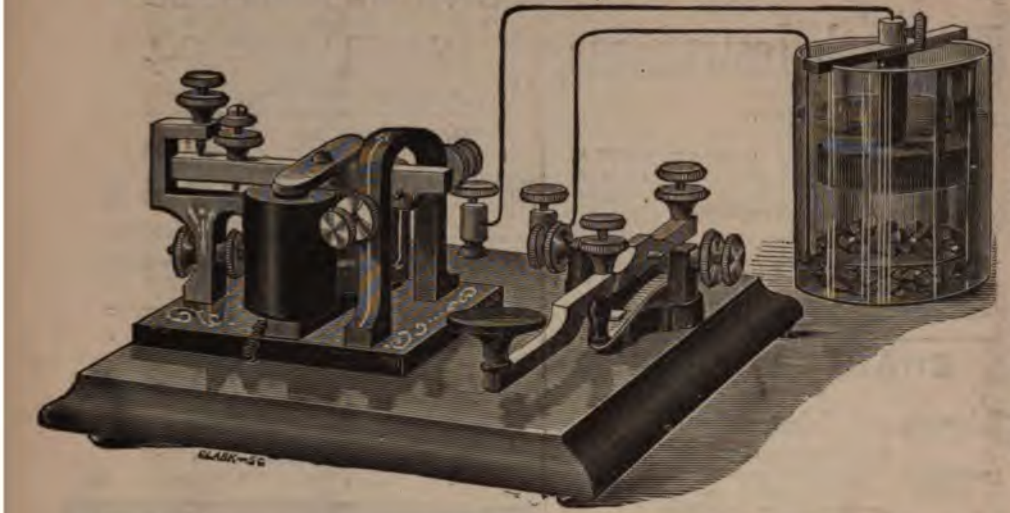

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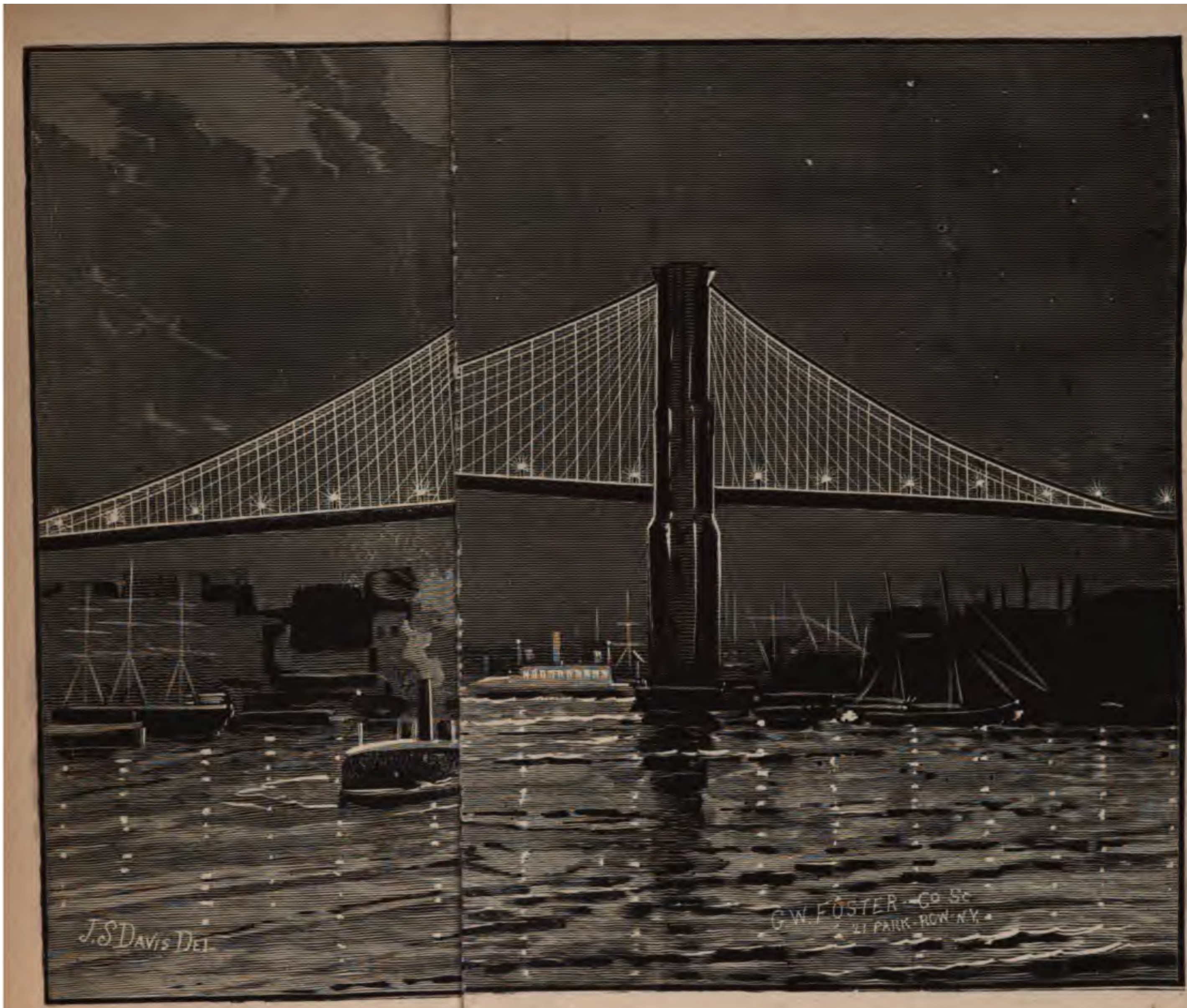
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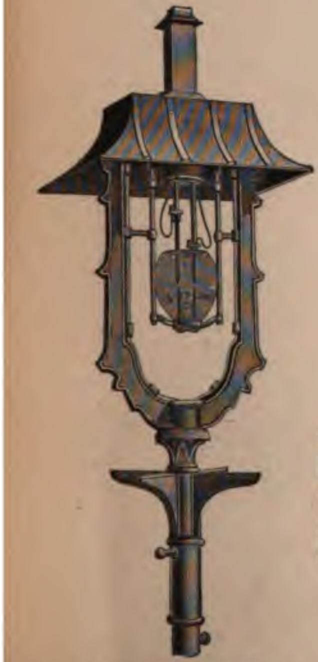

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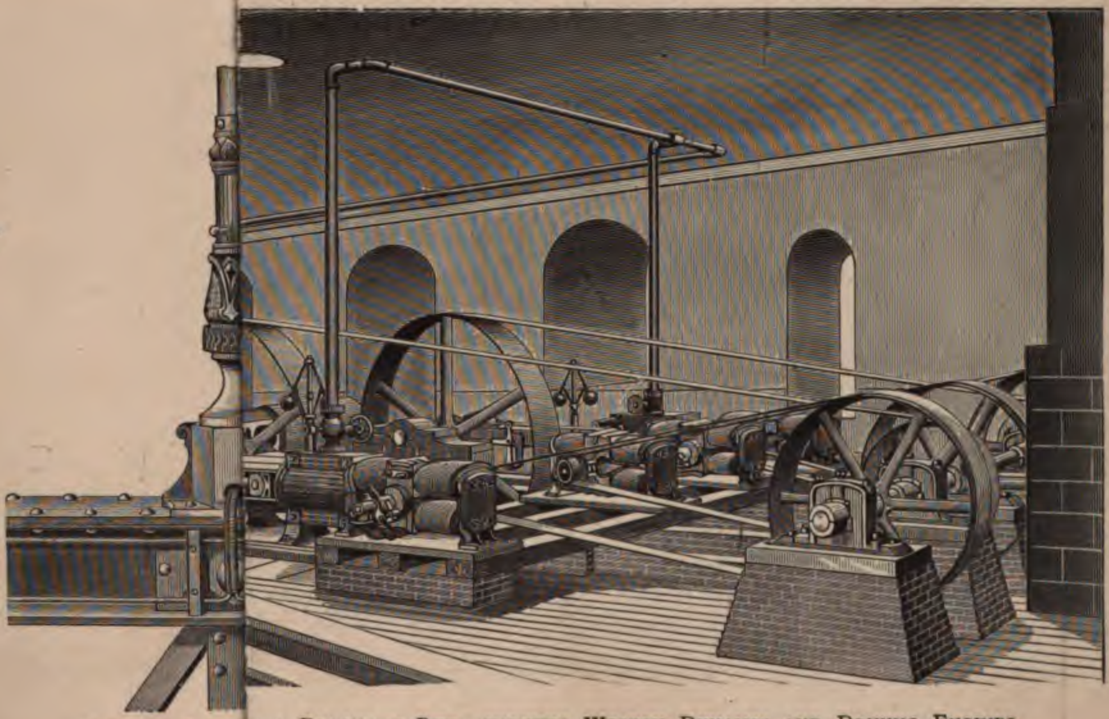

Base of Lamp ear Brooklyn Pier, showing Weston Dynamos and Driving Engines.

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Vol. II. No. 6.] JUNE, 1883. [$1.00 a Year. 10 Cents a Copy.

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ELECTRIC LIGHT ON THE BROOKLYN BRIDGE.

THE most noteworthy of the recent electric light installations is the plant erected by the United States Illuminating Company, of this city, for lighting the Brooklyn Bridge and its approaches. The intense interest of the public in everything connected with the great bridge, and the very conspicuous position in which the lights are placed, will probably attract more attention to this plant than to any other which has been put in operation for a long time.

It is a striking commentary on the progress made in electric lighting, that when the bridge was commenced no one would have thought of lighting it by electricity when completed, except as a remote possibility not worthy of serious consideration, but when the time came for awarding the contract no other light was seriously considered. As will be remembered this contract was the subject of extremely spirited competition between all the principal electric light companies, and was finally awarded by a committee of the board of trustees, after an unusually careful investigation of the whole subject. The following extract from the official report of the committee is of interest, as giving the principal considerations by which the committee was influenced in making its decision.

"The proposal of the Edison Company involved the use of incandescent lights, and was not favorably considered, as it appeared to the committee that greater economy of power and more perfect general illumination could be obtained, in lighting large spaces, such as the roadways of the bridge, by the use of powerful arc lights.

"Of the different arc systems represented, the Weston system, used by the United States Company, and the Brush system, used by the Brush Swan Company, seem to present greater advantages than the others. Both of these systems are well-known and have for a long time been in successful and very extensive use throughout the country, and the companies which are introducing them are doing a large business and have had great experience in carrying out installations similar to that desired for the bridge.

"While there seems to be little room for choice between the two systems in regard to reliability of the apparatus for continuous use, the Weston system appears, from the facts presented to the committee, superior to the Brush in other respects, and especially in economy of power, and in safety.

"The engineers of the bridge have carefully examined the Weston apparatus, and are of the opinion that it is admirably designed and well-constructed, and the large number of lights of this system which they have observed in operation in New York city appear to be working in a very satisfactory manner.

"It appears that tests and measurements which have been made of different dynamo machines, with reference to economy of power, and especially those conducted by the committee, appointed for that purpose, at the Paris Electrical Exposition, show a considerably higher efficiency for the Weston dynamo than for the Brush, or for any of the others which have been brought into competition with it; and it is stated by the representatives of the United States Company that important improvements have been made in the Weston machine since these tests were made, which makes its superiority in this respect still greater.

"As the expense of supplying power to operate the lights is to be borne by the bridge corporation, and will be continuous, any considerable reduction in the amount of power required appears to be a very material consideration.

"In view of the numerous reports of fatal accidents occasioned by persons coming accidentally into contact with the wires of electric lighting circuits in which a current of very high tension is employed, the committee inquired very carefully into the relative safety of the different systems submitted, and, from the facts elicited, is convinced that the advantages of the Weston system in this respect are very marked. The Weston lamp is constructed to work with a very short arc or separation between the carbon points (the length of the Weston arc being about $\frac{1}{32}$ of an inch, while the arc employed in the other systems is from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch in length), and the tension of the current required for working a given number of lamps in the same circuit in the Weston system is correspondingly low. The Weston current is also continuous and uniform, while in some of the other systems—notably in the Brush—the current is pulsating in its character; and all writers on the subject appear to agree that a pulsating current is much more dangerous than a continuous one of the same tension.

"As the bridge is to constitute a great public thoroughfare, and any defect of insulation or accidental displacement of the wires might bring the iron work of the structure into the circuit, it seemed to the committee in the highest degree objectionable to permit the use of such a current as would be capable of doing deadly harm. A current of very high tension, especially when it is pulsating in its character, appears to be capable of producing injurious, and even fatal shocks, while with a continuous-current of comparatively low tension, such as is used in the Weston system, such danger is not to be apprehended."

Judging from the character of the work done, the decision of the committee, in awarding the contract to the United States Company, seems to be fully justified, as all the details of the installation have been carried out in the most careful manner, and the results obtained are extremely satisfactory.

Our illustrations give a good idea of the general effect produced by the lights, and some of the more interesting details of the plant.

There are in all, seventy arc lamps of the Weston double carbon type, arranged in two circuits of thirty-five lamps each. Of these, fourteen are placed on the main span, fifty on the approaches, and the remainder in the stations at each end, and in the engine house. The two circuits are entirely independent of each other, and are so arranged as to take in alternate lamps entirely around the bridge. This is well shown in the diagram of circuits given in the cuts. As the bridge, with its approaches, is more than a mile in length, the two circuits comprise more than four miles of line wire. Each circuit is worked by two twenty-light Weston dynamos, coupled in tension, and driven by an independent Corliss engine, of the Watts-Campbell type. Considerable margin has been provided both in dynamos and steam plant, in view of a probable increase in the number of lights. The dynamos and engines are placed in the main engine house, on the Brooklyn side, and arranged as shown in the cut.

As the structure of the bridge is mainly of iron, unusual difficulties have been encountered in regard to insulation; but these have been surmounted in a very satisfactory manner, and the arrangement and erection of the circuits is especially to be commended. The wire used for the mains is insulated by a thick coating of kerite, wound with kerite tape, and the whole enclosed in a stout sheathing of braided cotton. For the main part of the bridge and approaches, the wires are carried along on the face of the trusses, over the railway tracks, and secured at intervals of a few feet by passing through cleats of wood boiled in paraffine, which are bolted to the iron work. Where the wires pass around the buttresses at the ends of the approaches, or are brought within reach of either the foot walk or drive way, they are brought together, wrapped with a thick covering of kerite tape and enclosed in an iron gas pipe. The wires which are alongside of each other are of different circuits, the out and return wires of each circuit being on opposite sides of the bridge. The lamp posts are mounted on the top of the trusses and the wires are taken off inside of the posts to the lamps, as shown in the cuts.

As the alternate lamps are entirely independent of each other, in regard both to circuits, and to dynamos and engines, the chance of any accidental stoppage of all the lights seems very remote; but in order to provide every possible safeguard, arrangements have been made for connecting the bridge circuits with the lighting stations of the U. S. Illuminating Co. in New York whenever desired. For this purpose mains have been run from the stations to the New York end of the bridge, and connected with cut-off boxes in the bridge circuits, and similar cut-off boxes have been placed in the engine house on the Brooklyn side. These are shown at A A in our diagram. By closing the switches on the Brooklyn side, and opening those on the New York side, the bridge circuits are interposed as loops in the lines from the stations.

The engines are to be supplied with steam from the main boilers, used for operating the railway on the bridge, and as these are not yet in place, the lights are run for the present from the Illuminating Company's station on Elm Street.

PROF. S. P. THOMPSON'S NEW TELEPHONES.

THE telephonic apparatus recently patented by Prof. S. P. Thompson, of University College, Bristol, is so simple and in many respects so suggestive, that it may be useful, as it certainly will be interesting, if we illustrate some of the forms devised by him. The improvements relate to telephonic transmitters based upon the principle discovered by Philipp Reis in 1861, namely, that of employing current-regulators actuated, either directly or indirectly, by the sound waves produced by the voice. By the term current-regulator is meant a device similar to that employed by Reis, wherein a loose contact between two parts of a circuit (in which are included a battery and a telephonic receiver) offers greater or less resistance to the flow of the electric current, the degree of intimacy of contact between the conducting pieces being altered by the vibrations of the voice. In Reis's transmitter, and in Edison's transmitter, and other well-known forms of these instruments, the action is indirect, a tympanum of stretched membrane or other equivalent organ, such as a diaphragm of mica, being used to collect or magnify, or concentrate the vibrations of the voice, and to convey them to the point or points of loose contact that regulate the current. In other forms of transmitters (for example, some of Hughes's microphones), the mode of action is direct, the air waves beating directly upon the conductors or electrodes which are in loose contact, without the intermediation of a tympanum or diaphragm. Of these two classes of telephone transmitters, viz:—those in which the current-regulator is combined with a tympanum or diaphragm, and those in which the current-regulator is acted upon directly by the air waves of the voice, the improvements relate to the latter only, as Prof. Thompson dispenses with the membrane tympanum used in Reis's transmitter; and does not employ the tympanic diaphragm of mica used in Edison's transmitter; he does

FIG. 1

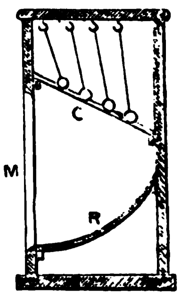


FIG. 5

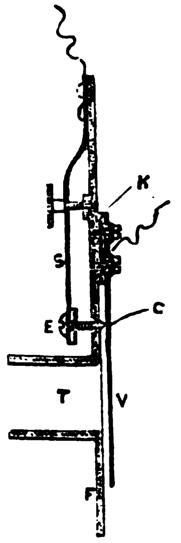


FIG. 4

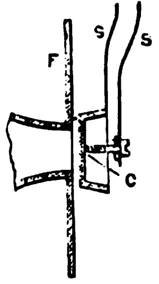


FIG. 2

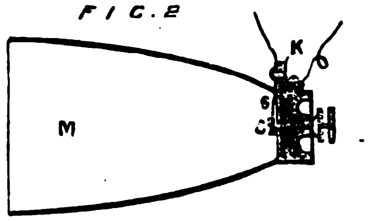
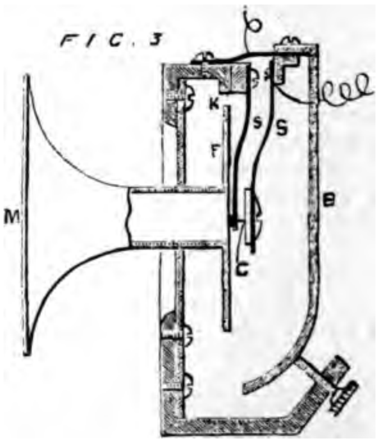


FIG. 3



not even employ any diaphragm in the sense of a partition between the current-regulator and the air waves of the voice, as in Theiler's transmitter. In the improved transmitters, the air waves act directly upon the current-regulator itself. As a result, the articulation is clearer for some of the consonantal sounds, which are only imperfectly or difficultly transmitted by telephones in which the current-regulator is affected indirectly through a tympanum, diaphragm or partition. Transmitters of the class to which the improvements relate are, ordinarily, liable to two defects. Firstly, they do not articulate so loudly as transmitters in which there is a tympanum or diaphragm to collect or magnify the vibrations. Secondly, when, to obviate this difficulty, the speaker speaks with his mouth very close to the current-regulator, the moisture of his breath condenses upon the contact points or adjacent parts of the regulator, interfering with its action and spoiling the articulation. The improvements relate chiefly to means for remedying or obviating these defects. Prof. Thompson proposes to employ mirrors sound reflectors or reverberators (one form of which is shown in Fig. 1, in transverse section), consisting of glass, metal, wood, or other material, by which the sound waves are turned aside from their straight or direct path, and are made to converge upon the current-regulator, precisely as rays of light may be turned aside or converged by a polished mirror. If actual mirrors of polished metal or silvered glass are employed for this purpose, they have the additional advantage of revealing to the speaker the presence of moisture. But in any case the mirror, reflector or reverberator serves to collect the sound waves as they come from the speaker's mouth, and to direct them on to the current-regulator while intercepting moisture from the speaker's breath. M is the mouth piece or tube; C is the current-regulator; R is the reverberator. An adjusting screw and an outlet cock for the water which collects in the mouth tube are also provided where necessary. The mouth pieces, hitherto used on ordinary transmitters, are not intended to serve either as reverberators or as protectors from moisture, and Prof. Thompson finds that mouth pieces for this purpose must, as shown in Fig. 2, be deep and of conical or paraboloidal form. Another part of the invention consists in employing, for the current-regulator, such materials as are at once neither hygroscopic, nor liable, by their properties with respect to heat, to condense films of moisture, while at the same time they are good conductors of electricity. Prof. Thompson prefers to use, as materials for the current-regulator, either spongy platinum, carbide of platinum, boron, coke, carbon, or elastic carbon specially prepared, having first deprived such materials of their hygroscopic properties by treatment with petroleum, or with other suitable hydrocarbon, solid or liquid. In some cases, and especially where the contact surfaces of the current-regulator are of platinum or other metal, he finds it convenient to keep their surfaces constantly moistened with petroleum or other hydrocarbon by supplying them through a cotton filament in communication with a small lubricator or oil vessel. The improvements also partly consist in so arranging the conductors or electrodes, or other parts of the current-regulator, that the points of loose contact can be actuated by the sound waves, whilst they are protected from the moisture of the breath by some portion of the conductors or electrodes projecting between the contact points and the breath of the speaker. An example of such an arrangement is given in Fig. 4, wherein the contact points C are protected from the breath by making one of the electrodes in the form of a cup, against the concave or hollow face of which the contact point on the other electrode is directed. The improvements relate further, to the form of the conductors or electrodes, combined to serve as the current-regulator. The current-regulator of Reis, consisting of one piece of platinum resting lightly against another, is imperfect, except when, as in some forms of Reis's instrument, one or both of the pieces of metal are fixed upon springs or some equivalent elastic support; otherwise the current is liable to very abrupt interruptions. In Fig. 3 is shown a current-regulator, wherein the two contact pieces are held upon springs S, S; one of these springs is fixed to an adjusting frame B, and the other is fixed to an insulating block K, for it is found that when there are many points of contact instead of but a single pair of such points, there is less liability to such abruptness. Multiple contacts, therefore, are advantageous. One of the improved forms of current-regulator consists of a grating or framework of prepared carbon or metal tongues, so connected that the current cannot pass from one tongue to the next except through a piece or pieces of good conducting carbon or metal suspended, or resting in loose contact against the tongues. In the instrument shown in Fig. 1, the current-regulator C consists of an inclined grating of carbon strips, against which the voice waves are reflected by the reverberator R, and upon which rest light balls of carbon, or of metal suspended from hooks by silken strings. In some cases, where a highly powerful action is desired, the air waves are caused to act first on a vibrating tongue which then transfers the vibrations indirectly to the current-regulator or contact points C. Such a vibrating tongue is shown at V, in Fig. 5, where it is attached behind a flanged tube T, the contact points or current-regulator C being on the same face of the tongue V as that against which the voice waves impinge. This tongue may be itself an electrode, and serve as part of the current-regulator, in which case it is formed of metal, carbon, or elastic conductor, whether anhygroscopic or not.—*English Mechanic.*

RECENT INFLUENCE-MACHINES.

SEVERAL modified types of influence-machines have recently been brought before the public, and as they are both cheaper and more efficient than the older forms of Töpler, Holtz, and Bertsch, will probably find general acceptance. Of the newer forms, those of Voss and of Wimshurst are the most prominent.

In the Voss machine, which may be regarded as a modified Töpler machine, there are two discs of varnished glass, one stationary, the other rotating in front of it on an axis which passes through a central hole through the fixed disc. A pair of pulleys with a strap provide the rapid movement necessary. At the back of the fixed disc are fixed two armatures, or inductors, of varnished paper, with a narrower central band of tinfoil. These armatures are connected on the right and left respectively with two metal clamps, which nip on to the edge of the disc and turn round in front of the front plate, each being provided at this part with a little metallic brush. Upon the front of the rotating plate are fastened six or eight metal buttons at equal intervals. These buttons are touched as they rotate by the metallic brushes. Nearly perpendicular, and in front of the front disc, is a brass rod, which need not be insulated, also furnished with spikes at each end, and with a little metallic brush to touch the buttons of the rotating plate. The action of the machine is as follows: If a small charge of electricity—say a positive charge—be imparted to one armature—say that on the left—the buttons, as they move past, will be acted on inductively, and if, while thus under the inductive influence of the positive charge, they are momentarily touched by an uninsulated conductor, they will pass on electrified with a charge of the opposite sign. If the front plate rotates in the clockwise direction, each button, as it moves through its highest position towards the right, will thus acquire a small negative charge, which will be given up on arriving at the right side, the projecting arm conveying the charge to the armature at the back. But as the button passes on downwards it will be influenced inductively by the armature behind it, and when touched by the lower end of the vertical conductor, will assume a positive electrification. On arriving at the left side it will, therefore, give up a small positive charge to the left armature, thus charging it more highly than before. Every button, as it goes round, thus conveys the charges induced in it to the appropriate armatures, and exalts their charge. A very few turns given to the handle suffice to charge those armatures to their fullest extent, so that they begin to discharge pale sparks over the discs. But now begins another action. From right to left in front of the front disc lies an insulating bar of ebonite, holding at each end another brass comb, each connected by a crossbar of brass to the knob of a small Leyden jar. As the charges in the armature rise, they act again upon these conductors fixed in front of them, and charge the jars—one positively, the other negatively. A pair of dischargers, with ebonite handles, serve to discharge the jars when full, and with every turn of the winch, when the knobs of the dischargers are separated by a few centimetres' distance, a torrent of sparks is generated. If the machine is kept free from damp and dust, no initial charge is necessary, as the slight friction of the brushes suffice, to give and sustain the requisite preliminary electrification.

Wimshurst's influence-machine is even simpler, and, if anything, more efficient. It is the result of a long experimental research carried out with great care and skill by Mr. J. Wimshurst, who is well known as an accomplished amateur electrician. The latest of the many combinations which Mr. Wimshurst has designed is depicted in Fig. 2. It consists of two discs of common window glass, mounted upon a common spindle, and provided with driving gear by which an equal speed is given to each, but in opposite directions. Each disc (about fourteen inches in diameter in the smallest size) is well varnished with shellac varnish, and carries twelve narrow strips of thin sheet metal, cemented at regular intervals apart. In front, at about 45°, is fixed a diagonal conductor, armed at each end with a small brush of metallic bristles, which touch the metal strips as they rotate. At the back a similar diagonal conductor is fixed, exactly at right angles to that in front. Right and left are two upright pillars of glass, or ebonite, which carry each a pair of metallic combs, and serve also to support the dischargers, which are carried in an arch over the discs. It appears that in this machine the metal strips affixed to the plates act both as inductors and as carriers. Suppose, for example, that the front plate is rotating clockwise, and the back plate counter-clockwise, If the metal strips descending from the summit on the left on the back disc are charged positively, the metal strips ascending on the front disc from the left will, as they pass under the momentary touch of the brush, acquire a negative charge. As these negatively charged strips of the front plate advance towards the right, they will come to a point where they are opposite the upper end of the hinder diagonal conductor, and here, whilst still acting as carriers to bring the negative charge round to the right side, they will act as inductors, and will influence the strips of the back disc, which will, as they are in turn touched by the hinder brush, acquire positive charges. The strips on the front disc will, therefore, constantly carry a negative charge as they move over the top from left to right, and those of the back disc will carry a positive charge from right to left. In the lower halves of their respective rotations, the inverse of these actions will hold good, the front carriers conveying positive charges from right to left, the back ones conveying negative charges from left to right. The result will, of course, be that the two main conductors on the left and right will become, respectively, positively and negatively charged. Theoretically, a small initial charge must be imparted to some one or more of the carriers, or to one of the two main conductors. Practically, if dry and free from dust, the machine excites itself, and, after a couple of turns have been given to the handle, discharges sparks freely. If the two main conductors are respectively joined to the inner and outer coatings of a large Leyden jar, the discharges take place with short, loud sparks of great brilliancy. If, from any cause, the machine does not at once charge itself, a gentle rub with a silk handkerchief on either of the ebonite pillars will suffice to provide the requisite stimulus. The Wimshurst machine appears to be less liable than any other influence-machine to have the polarity of its charge reversed. It serves admirably for the production of the electric shadows discovered by Holtz and Righi. Mr. Wimshurst is much to be congratulated on the service he has rendered to experimental science in devising so useful and efficient an instrument.—*Nature.*

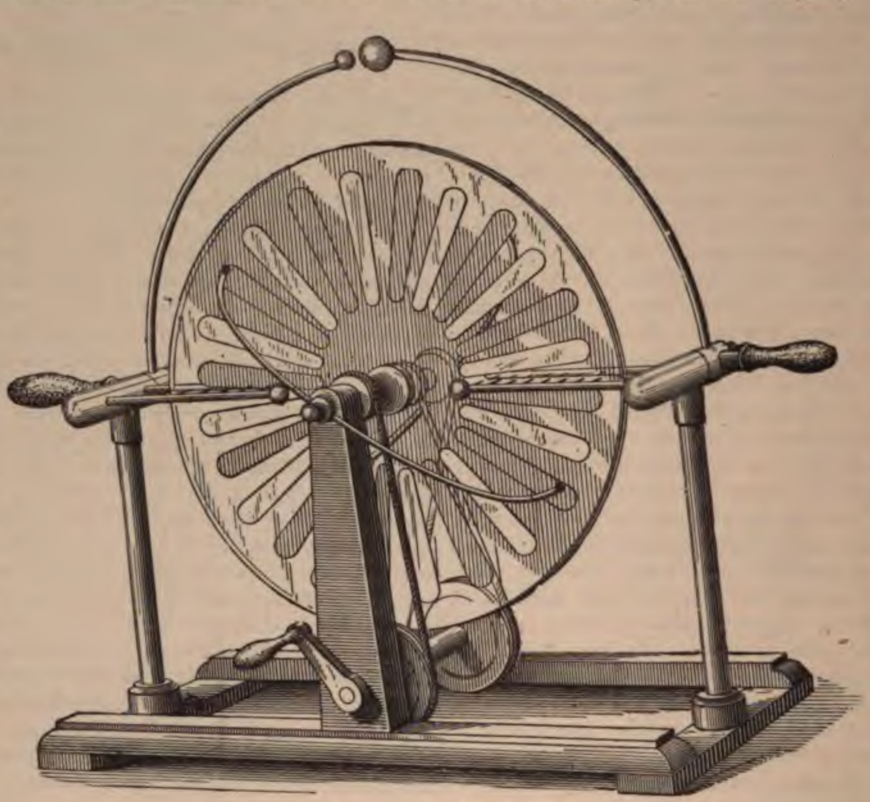


FIG. 2.—WIMSHURST'S INFLUENCE-MACHINE.

THE TRANSMISSION OF POWER BY ELECTRICITY.

CHICAGO, May 2, 1883.

To the Editor of the Electrician :

Dear Sir—At the sixty-sixth regular meeting of the Chicago Electrical Society, held April 23, the following named persons were elected members: George H. Bliss, F. W. S. Brawley, C. N. Fay, J. W. Fortune, P. D Johnston, James D. Sturges, A. S. Porter, and F. H. Wachsmuth.

The paper for the evening, by Prof. H. S. Carhart, of the Northwestern University, at Evanston, was fully illustrated by large charts, containing diagrams and formulæ. We give herewith the full text of the lecture:

The transmission of power by electricity, through a wire offering but a limited resistance, has already been successfully accomplished. Since a dynamo-electric generator may serve also as an efficient electromotor, the invention of a thoroughly successful generator of electricity from mechanical power solved the problem of the recovery of a large per cent of this power from the electric current at a more or less remote distance. Even this problem, which can be of only limited practical application, is of great theoretical interest; and its discussion opens the way to the study of the broader question of transmission to a great distance and over great resistance.

Scientific measurements of all sorts have been greatly facilitated in the last few years by the introduction of the so-called "absolute units;" and no department of scientific work has gained more by this advance than electricity and magnetism.

In the absolute system of units only three are fundamental—the units of length, of mass, and of time. All other units are derived from and expressed in terms of these three. The British Association chose the centimetre, the gramme, and the second, as the three fundamental units; and the Congress of Electricians at Paris, in 1881, set the seal of universal scientific approval upon the British Association system. Hence any one who wishes to express himself in current and approved scientific phraseology must employ the "C. G. S." (centimetre, gramme, second) system of units.

From these fundamental units it turns out that the derived unit of electrical resistance is a velocity; and the practical unit of resistance, the *ohm*, is equal to 10^9 C. G. S. units—that is, a number represented by 1 with nine ciphers following. Similarly the practical unit of electro-motive force is the *volt*, and equals 10^8 C. G. S. units.

Therefore by Ohm's law $C = \frac{E}{R} = \frac{E\,10^8}{R\,10^9}$ C. G. S. units of current.

Or, $\frac{E \text{ (volts)}}{R \text{ (ohms)}} = C$ (ampéres) $= \frac{1}{10}\,C$ (C. G. S. units of current).

That is, an ampére, which is a current due to an E. M. F. of one volt through a resistance of one ohm, is equal to $\frac{1}{10}$ of a C. G. S. unit of current (electro-magnetic). An ampére measures *current strength*. If a current of one ampére intensity flows for one second of time, a quantity of one coulomb passes. The *coulomb* is, therefore, the unit of *quantity*. These two terms have replaced the old expressions "weber" and "weber per second."

In the C. G. S system the unit of force is the *dyne*, a force which will give to a gramme a velocity of one centimetre in a second; if this force acts over a distance of one centimetre it does one unit of work, called the *erg*. But instead of expressing the work done by a current in ergs, it is desirable to be able to express it in the more popular terms of horse-power, which is a *rate* of doing work. The number of ergs of work done by a current is equal to the product of the quantity of electricity into the difference of potential through which it is transferred, both quantity and difference of potential, or E. M. F., being measured in absolute units of the electro-magnetic system.

Therefore, $W = C\,E$,

or, W (ergs) $= C$ (coulombs) $10^{-1} \times E$ (volts) 10^8,

W (ergs) $= C$ (coulombs) $\times E$ (volts) 10^7.

One horse-power is equivalent to lifting 33,000 lbs. one foot high per minute; equals 550 ft. lbs. per second, equals 76×10^5 gramme-centimetres per second. But since the gramme is a unit of mass, to get the work done, we must multiply by the gravitating force of a gramme, or 981; that is, a falling body acquires a velocity of 981 cm. in a second. Hence, 76×10^5 gm. cm. per second, equals 746×10^7 ergs per second. Since one horse-power equals 746×10^7 ergs per second, to express the above equation for the work of a current in horse-power, we must divide by 746×10^7.

$$W \text{ (h. p)} = \frac{C \text{ (coulombs)} \times E \text{ (volts) } 10^7}{746 \times 10^7}, \text{ or}$$

$$W \text{ (h. p.)} = \frac{C \text{ (coulombs)} \times E \text{ (volts)}}{746}.$$

It is of the highest practical importance, therefore, that our instruments for measuring current strength should be graduated in *ampéres*; and those for difference of potential between two points in *volts*, in order that we may quickly and readily determine the amount of energy absorbed between two given points in horse-power, simply by multiplying together the numbers expressing ampéres and volts, and dividing the product by 746.

Dr. Siemens has suggested that the unit of power be the Watt, which is $\frac{1}{746}$ of a horse-power. Hence the product of ampéres and volts is Watts.

If we substitute in the general expression for the energy of a current, $W = C\,E$, the value of C, or $\frac{E}{R}$, we have

$$W = \frac{E^2}{R}$$

This shows that when the resistance remains constant, the work done by a current, or the energy it represents, varies directly as the square of the electro-motive force.

But if an electro-motor be included in the circuit, the reaction between the fixed magnets and the moving armature generates an inverse E. M. F.; and the actual E. M. F., producing a current through the wire connecting the generator and the motor, will be that furnished by the source of supply, *minus* the counter E. M. F. due to the motor. Calling these E and e, the current will be $\frac{E - e}{R}$, where R is the total resistance in circuit.

Hence, $W = C\,E = \frac{E\,(E - e)}{R}$, for work done by the generator; and $w = \frac{e\,(E - e)}{R}$ for that given out by the motor, both measured electrically.

Let us now illustrate this diagrammatically by the method of Prof. Silvanus Thompson, in order to represent to the eye both the *maximum rate* of working and the *maximum efficiency* of the motor.

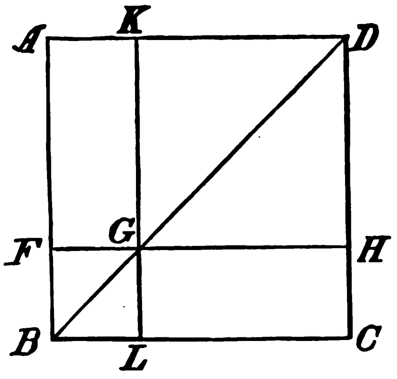


Fig. 1.

The figure is a square, and either side, as $A\ B$, represents the E. M. F. of the generator when the motor is at rest. $B\ F$ represents the counter E. M. F. of the motor. $A\ F$ is, therefore, $E - e$, and the area $A\ F\ H\ D = E\,(E - e)$, and area $G\ L\ C\ H = e\,(E - e)$.

If the resistance remains constant, these areas will represent the energy absorbed by the generator, and that given out again by the motor. In both cases the energy is measured electrically, and the machines are supposed to be perfect. The ratio of the two areas on the diagram is, accordingly, the measure of the efficiency of the motor.

Fig. 2 is intended to illustrate the law of *maximum rate of working*.

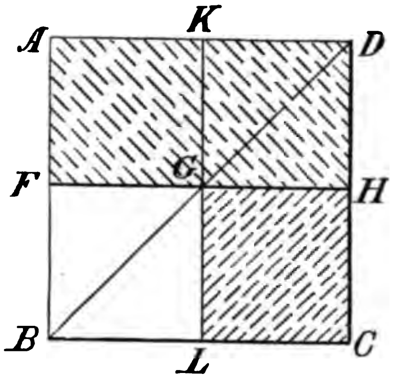


Fig. 2.

The point G is at the middle of $B\ D$. Since this point always lies on the diagonal $B\ D$, the area representing the work done by the motor must always be inscribed in the triangle $B\ C\ D$; and of all rectangles so inscribed, the square $G\ L\ C\ H$ has the greatest area. But the area of the square is exactly half that of the rectangle $A\ F\ H\ D$. Hence, work by the motor is done *most rapidly*, when the energy it absorbs is half that derived from the source of supply. This is known as Jacobi's law of the maximum rate of working. The *efficiency* of the motor is, accordingly, only 50 per cent. when it is doing work at the most rapid rate, with a given source of supply. Maximum rate of working and maximum efficiency are, therefore, clearly not identical.

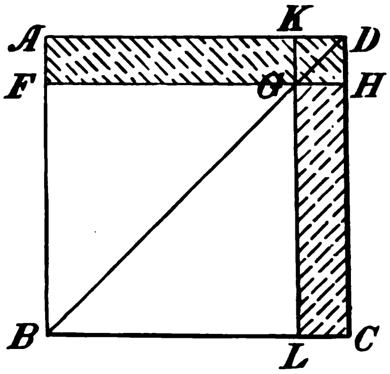


Fig. 3.

Consider further, Fig. 3, when the speed of the motor is still higher, and the counter E. M. F. correspondingly great. The point G is still nearer D; the area $G\ L\ C\ H$ is approaching $A\ F\ H\ D$ in value, and the efficiency of the motor is nearly a maximum. The area of the small square $K\ G\ H\ D$ represents the loss due to heat-waste in the resistances. That the efficiency may be a maximum, the heat-waste must be a minimum. It is, therefore, evident that the efficiency is a maximum when the motor is running with a velocity nearly equal to that of the generator. In other words, the maximum of power employed will be turned into useful work when the motor is running under a very light load. Maximum rate of working, however, is attained at a theoretical efficiency of 50 per cent. But when the motor is converting the largest possible proportion of the energy employed into useful work, it is running under a very light load. This is analogous to battery power required for electroplating. The greatest economy of working is to use a current of E. M. F. just sufficient to decompose the metallic salts employed. If double this E. M. F. is used, the rate of electro-deposit will be doubled, but it will be at the cost of four times as much zinc.

For economical working in the transmission of power, it is necessary that the difference between the E. M. F. of the generator and the motor be small. The question of the absolute values of these E. M. F.'s is one now to be considered From the above expressions for the energy absorbed by the generator and that returned by the motor, we see that the ratio of the two is simply the ratio of E and e, provided their difference and the resistance remain constant, which is equivalent to saying that the current remains constant. It follows, directly, that the higher the direct and counter E. M. F.'s, the greater the power transmitted with a given current over a given resistance.

Let us illustrate, by reference to the Gramme machine, used in the Chatham experiments in England. The following data are given:

$$E = 69.9 \text{ volts.}$$
$$r = 0.15 \text{ ohm.}$$
$$r' = 0.06 \text{ ''}$$
$$R = 0.65 \text{ ''}$$

In which r is the resistance of the field magnets, r' of the armature, and R the external resistance. It follows, that

$$C = \frac{69.9}{0.86} = 81.22 \text{ ampéres.}$$
$$W = 81.22 \times 69\ 9 = 5677.3 \text{ Watts} = 7.6 \text{ h. p.}$$

Suppose, now, the total resistance be increased to 10 ohms, and that the E. M. F. be so increased that the same current of 81.22 ampéres flows. The E. M. F. wiil then be 812.2, for

$$C = \frac{812.2}{10} = 81.22 \text{ ampéres,}$$

as before. In order to furnish this current through 10 ohms resistance, the dynamo would absorb 88 h. p., instead of 7.6 as before. Further, let the dynamo be connected with a motor running so as to produce a counter E. M. F. of 612.2 volts.

Then the following are the data:

$$E = 812.2 \qquad E - e = 200 \qquad r + r' + R = 10$$
$$e = 612.2$$

$$\text{Hence, } C = \frac{200}{10} = 20 \text{ ampéres.}$$
$$W = \frac{812.2\ (812.2 - 612.2)}{10} = 16{,}244 \text{ Watts, or } 22 \text{ h. p.}$$
$$w = \frac{612.2\ (812.2 - 612.2)}{10} = 12{,}244 \text{ Watts or } 16.4 \text{ h. p.}$$

Let the resistance be further increased to 100 ohms, and the E. M. F.'s to 2,500, and 1,500 volts respectively.

$$\text{Then } C = \frac{E - e}{R} = \frac{1000}{100} = 10 \text{ ampéres.}$$
$$W = \frac{2{,}500\ (2{,}500 - 1{,}500)}{100} = 25{,}000 \text{ Watts, or } 33.5 \text{ h. p.}$$
$$w = \frac{1{,}500\ (2{,}500 - 1{,}500)}{100} = 15{,}000 \text{ Watts, or } 20.1 \text{ h. p.}$$

Thus, while the current in the three cases varies from about 80 ampéres to 20, and then to 10; and the E. M. F. of the generator rises from 69.9 to 2,500 volts, the power absorbed passes from 7.6 h. p. to 22, and finally, to 33.5. With a decreasing current, therefore, and an increasing resistance it is possible to transmit more and more power, provided the E. M. F. be made sufficiently high.

These results show, conclusively, that if we desire to transmit any considerable amount of power over a resistance as great as 75 or 100 ohms, we can do so with reasonable efficiency only when the generator dynamo and the motor dynamo, are so constructed as to yield a very high E. M. F., the one direct and the other reverse or counter. Then, with a given difference of E. M. F. between the two machines, and a given resistance in the main circuit, the efficiency of the combination and the power transmitted will vary almost directly as the E. M. F. of the generator, the current intensity remaining the same.

This conclusion, which seems at first self-contradictory, becomes evident when we consider that the energy represented depends not on the current strength alone, but on the E. M. F. and the current conjointly; and in this combination of two dynamos, we have the means of varying the effective E. M. F., which determines the power transmitted, while the current intensity remains the same. For a short circuit of low resistance, comparatively low E. M. F.'s will suffice; while for high resistances correspondingly high E. M. F.'s must be employed. This is in reality no new law, though it has been sounded abroad of late in certain quarters with a great flourish of trumpets. When Prof. Joseph Henry took up the task, in which others had failed, of producing at a distance mechanical effects which had previously been obtained only with a short wire of low resistance, he made the capital discovery that he must do two things; first, increase the E. M. F. by joining a number of cells of battery in series; and, second, increase the number of turns of wire on the magnets of his receiving instrument. Exactly the same method must be pursued in transmitting power to a distance by means of dynamos. The E. M. F. of the generator must be increased, and the number of turns of wire on the armature of the motor must also be multiplied, or the same result accomplished by other and corresponding means.

But what practical limits are placed on the increase of E. M. F? There are three methods of exalting it.

First, by increasing the strength of the magnetic field due to the fixed field magnets.

Second, by increasing the number of turns of wire, and, in consequence, the resistance of the armature.

Third, by increasing the velocity of rotation of the working magnet.

With only these means at command, the limit of attainable E. M. F. is not indefinitely high. This fixes a corresponding limit to the resistance over which power can be economically transmitted. For the economical transmission of power several hundred miles, over a conductor of moderate size, an E. M. F. comparable with that furnished by a Holtz machine would be needed. Further, the employment of E. M. F.'s of such magnitude is attended with great danger, even when both the direct and return conductors are insulated. An accidental short circuiting of the conductor is liable to generate a large amount of heat; and if such short circuit is through the person, death must follow. This latter result will most certainly take place if the current is characterized by a dangerous discontinuity, or intermittency. Such a current need not be an alternating one. In nearly all high E. M. F. dynamos, continuity of current has been sacrificed to strength of magnetic field. Professors Ayrton and Perry have devised a method of measuring this discontinuity, by means of an induction coil having low resistance in both the primary and secondary wires. When a current of ten ampéres, from a three-light Brush dynamo, was passed through the primary of the coil, an "ammeter" indicated a reverse current of five ampéres in the secondary. This reverse current was produced by the discontinuity of the main current repeating itself at such short intervals of time as to completely elude detection by any of the ordinary methods. Such intermittency in the current greatly augments the danger to life in case of accidental short circuits; or, indeed, where a partial ground is made by contact with an uncovered wire.

The practical transmission of power, by electricity, to any considerable distance, has thus far been quite limited. Dr. C. W. Siemens says, that "probably Sir Wm Armstrong was the first to take advantage of ascertained facts, in lighting his house at Cragside during night time, and working his lathe and saw bench during the day, by power transmitted through a wire, from a waterfall nearly a mile distant from his mansion."

In 1879, Dr. Werner Siemens operated an electric railway, at the Berlin Exhibition, 900 yards long and of 2 feet gauge. The car carried twenty persons at a trip.

The Lichterfelde line has been in operation since May 16, 1881. It has a gauge of 3 ft. 3 in., is 2,500 yards long, and is operated by two dynamos, developing an aggregate current of 9,000 Watts, or 12 h. p. It has never failed in accomplishing its daily traffic. What its relative economy is, is not stated.

The tramway at the Paris Exposition of Electricity was about 1,640 feet in length, and of 4 ft. 8½ in. gauge. In this line, contact was made with the suspended conductors by means of metallic bolts, drawn through tubes with a longitudinal slit. Ninety-five thousand passengers were carried within the period of seven weeks. Even when fully loaded, the car passed a considerable grade on entering the "Palais de l'Industrie," at a good speed.

Another electric tramway has just been successfully opened between Portrush and Bush Mills in the North of Ireland, a distance of six miles. The installation was made by the Siemens' firm of London. The rails on this line are three feet apart, and are not insulated from the earth, but are joined electrically by copper bolts, and form the return circuit, the current being conveyed to the car through a T iron placed on short standards. At present the power is supplied by a steam engine at Portrush, giving motion to a shunt dynamo of 20 h. p.; but the intention is to utilize water power near Bush Mills by means of three turbines of 40 h. p. each. The working speed of this line is restricted, by the board of trade, to ten miles an hour. This speed is readily attained, although the gradients are decidedly unfavorable, including an incline of two miles at a gradient of 1 in 38. It is intended to extend the line six miles beyond Bush Mills, in order to connect it with the North of Ireland narrow-gauge railway system. Theoretically, the most desirable system for street cars is to carry the store of energy in the tram itself instead of transmitting it over long distances. This plan has been tried with only moderate success thus far by the Electrical Storage Company of London, on the lines of the West Metropolitan Tramway Company. The accumulators are intended to furnish motive power for seven hours, the car accommodating forty-six passengers, and weighing, when loaded, seven tons. This plan appears to be entirely feasible; for while there is a loss of energy in a secondary battery, there is also a loss in transmitting over conductors from a central station. So also there is great loss in transmitting power mechanically by means of a wire cable. Consider only, the immense inertia of the cable, the friction, and the loss due to rigidity in passing round curves on the cable railway.

To sum up the points established:

1st. The maximum rate of working is attained when the motor converts half the energy supplied by the generator into useful work. This is Jacobi's law.

2nd. Maximum efficiency is attained only by allowing the motor to run under a light load at a high speed. The rate of working is then slow, but the largest possible proportion of the energy supplied is converted into useful work.

3d. When power is transmitted over considerable distances, the E. M. F. of both generator and motor must rise with the resistance

4th. With a given current over a given resistance, the power transmitted will increase directly as the E. M. F. of the generator rises; and the efficiency of the motor increases under the same conditions.

5th. A necessary limit to the E. M. F. is fixed by the mechanical conditions, and the scientific theory of the dynamo machine. Hence, the power that can be transmitted by electrical means over considerable resistances, is also limited, so far as known methods are concerned.

6th. The practical details of transmitting power electrically have not yet all been satisfactorily worked out; but enough has been done to indicate that the conclusions arrived at by theory are practically tenable.

The paper elicited considerable discussion, and many enquiries. The president announced that the annual election of officers would occur at the May meeting.

SCRIBE.

—— THE UTICA *Observer* says: That on the 12th of May, Messrs. Callanen & Parker, of Utica, set their long-distance telephone into a circuit of five Western Union wires (No. 9 galvanized iron), running between Utica and Albany, making a circuit of about 500 miles of continuous wire. The transmitter worked admirably, and was heard distinctly. As the Postal Telegraph Company uses copper wire with a steel core, which has a conductivity three times greater than the No. 9 galvanized wire used by the Utica inventors, Mr. Callanen claims that his test is equal to one of 3,000 miles on a copper steel cored wire, and that their transmitter is thus three times better than the one in use between New York and Chicago.

UNDERGROUND COMMUNICATION.

AT a meeting of the general committee on underground electrical communication, held at Room 47, 115 Broadway, May 7th, the following sub-committees were appointed:

SUB-COMMITTEE ON ELECTRICAL AND MECHANICAL DEVICES.

Albert B. Chandler, Joseph P. Davis, Frederick H. May, Henry Morton, Henry W. Pope, Garret S. Mott, Elihu Thomson, J. Eliot Smith. Instructed as follows:

It shall be the duty of the committee on electrical and mechanical devices, to examine inventions now in use, or that may be presented to it; to give notice to inventors as to the nature and extent of the requirements, and state the problem to be solved, with the purpose of concentrating inventive effort in a practical direction; and generally, to consider and report, for the instruction of the general committee, the state of the art; and that the difficulties are, or are not, surmounted, or, in the judgment of the committee, surmountable; and in default of an ideal and perfected system to make such recommendations to the general committee, as may in its estimation seem worthy of adoption, as a partial or temporary remedy of the difficulties encountered, pending the invention and perfecting of a completely satisfactory system. To report in the first instance to the committee on business.

SUB-COMMITTEE ON LAW AND FRANCHISES.

Leonard E. Curtis, Sherburne B. Eaton, William M. Ivins. Instructed as follows:

It shall be the duty of the committee on law and franchises to examine the laws and franchises granted by the State and city, and the general legislation favorable and unfavorable, bearing upon the subject; to determine whether any further powers are required, and if so, what, in order to carry out the plan of underground electric communication in the interest of all the electrical corporations, as approved by the committee on electrical and mechanical devices, and whether or not any general law on the subject is desirable; and further, in the event that the committee on inventions adopt any system, invention, or device, which is the subject of a patent of the United States, to examine, or cause to be examined, the validity of the same, and its scope and sufficiency. To report in the first instance to the committee on business

SUB-COMMITTEE ON BUSINESS ORGANIZATION.

Augustus C. Richards, Clark B. Hotchkiss, Charles R. Flint, Rowland R. Hazard, Thomas J. Montgomery. Instructed as follows:

It shall be the duty of the committee on business organization, if it shall appear from the conclusions of the two other committees, that a system is devised, or can be formed out of existing material, and that the required laws and franchises exist, to frame, for the consideration of the general committee, a plan of organization for carrying into effect the recommendations of the other committees, which shall include the formation of an independent company for that purpose, if that is deemed the better way, with the necessary by-laws for the same, and a system of control in the interest of the contributing corporations, it being understood that upon the completion of the work of the committee on business organization, the general committee shall be called together to act upon the reports of the three committees.

—— AN ELECTRIC LIGHT introduced in a Pennsylvania coal mine the other day, scared a lot of mules there out of their wits; and miners said it was the first time one of the animals was ever known to show fear underground.

—— *Engineering* states that the commission of the Vienna electrical exhibition is preparing iron cases, or screens, for the protection of the watches of those whose duty will carry them into the vicinity of powerful dynamo machines. The very serious mischief that was done to many valuable watches in the early days of electric lighting, led to the production of a machine by which the watch was steadily turned in front of a magnetic pole, until it was again demagnetised, but it will, no doubt, be more satisfactory to the owners of good watches to avoid the necessity of such experiments.

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UNDERGROUND CONDUCTORS.

IN our last issue, we referred to the action taken by the twenty-five telegraph, telephone, electric light and other electrical companies, doing business in this city, in organizing a general committee to consider the subject of a comprehensive system for placing their circuits underground. This committee has, since then, appointed sub-committees, of which we give the details in another column. As the actual work to be done will fall, for the most part, upon these sub-committees, we are pleased to see that excellent judgment has been shown in making them up.

The task which it is proposed to undertake, is by no means an easy one. The practical difficulties standing in the way of a satisfactory underground system, are probably greater in New York than anywhere else. Even if proper insulation can be secured, and induction obviated, we are met by the fact that the space beneath the pavement is, in very many of the streets, already fully occupied by sewers, gas pipes, water pipes, steam pipes, and pneumatic tubes, and that the number of circuits to be provided for is very great, and rapidly increasing.

Much good must result, however, from a thorough, practical investigation of the whole subject, such as this committee proposes to make.

There can be no doubt of a growing impatience on the part of the public, of the great accumulation of poles and overhead wires in the streets of our principal cities. Bills introduced in the legislatures of several of the States, and ordinances proposed or passed by many municipal bodies, indicate a disposition to legislate all circuits, in large cities, either underground or out of existence. These terms would, probably be, in many cases, synonomous, as for very many of the uses to which electric circuits are put, none of the proposed underground systems have been found reliable and efficient.

Legislators, not understanding this, and believing the only question involved to be one of slight additional expense, have been disposed to make regulations which, if enforced, would greatly restrict and cripple the business of all the electrical companies. Even if the question of expense were the only one, no stringent regulations should be adopted, without very careful consideration. Frequently, the development of a new business depends, at the outset, upon cheapness and rapidity of construction. The telephone business, for example, would probably not have reached a tenth part of its present magnitude under a prohibition of the use of overhead wires, even if any of the proposed underground systems were available for telephone circuits.

After all, the main question is, whether the benefits conferred on the public by the electrical companies, compensates for the inconveniences arising from the occupation of the streets with poles and wires. We think there can be but one answer to this question. The people of Chicago or St. Louis, for example, would probably bear with equanimity much greater evils than they are now suffering from overhead wires, if it were a question of having the circuits as they are, or not at all.

When it is generally understood that the difficulties in the way of getting the wires underground are more largely mechanical and electrical, than pecuniary, and that the companies are endeavoring, in good faith, to overcome them, there will be a much more conservative feeling in regard to legislation.

The work of the committee, if properly conducted, will be of importance, not only as bringing us nearer to a satisfactory solution of the problem, but as an assurance of the good faith of the companies, and as a means of information to the public.

The Gramme Company deserves great credit for taking the initiative in the matter; and the prompt coöperation of all the other companies, shows the very general interest which is felt in the subject.

THE INDIRECT VALUE OF THE ELECTRIC LIGHT.

THE results of experience add new elements of value to the electric light; matters formerly assumed to possess slight importance, have proved to be of great worth, while from day to day one learns of new applications, wherein the electric light has served to widen the scope of industries which it illuminated. These advantages are generally independent of the expense of the light, either in itself, or in comparison with other methods of illumination.

The vexed question of cost of electric light, is still in an unsettled condition, just as the same matter is unsolved in other industries. The members of the associations, devoted to the several leading industries, have long discussed the true cost of a ton of pig iron, of a bale of cotton, and of a bushel of wheat. The most careful observers disagree with each other in details, and final results.

In estimating the cost of lighting by electricity, the results vary with the opinions of the computers; elements of conjecture are amplified or diminished to any possible extent. We have seen such estimates based upon an average use of the light for two hours a day, where the cost of power was assumed as that necessary for the continual operation of the dynamo machines for ten hours daily; the assigned reason for such an extraordinary method of procedure, being that the establishment had facilities for the production of that power. Suppose the manager of a mill should report in a dull season, a production of cloth based upon the total capacity of the machinery, there would be a keen search for the missing goods.

On the other hand, one of the electric lighting companies published a letter from a manufacturer, who used a sufficient number of lights to require at least eighty horsepower, in which the statement was soberly made that "the increase of fuel required to run the dynamos was inappreciable." In the face of such diverse statements, and methods of calculation, it is well nigh impossible to make any report of value on the cost of electric lighting.

In all these estimates, the extent of the illumination is either disregarded, or compared with some previous methods of lighting, with a snap judgment which is unreliable. Whenever electricity is substituted for other methods of light, the result is always unsatisfactory, unless a notable increase of light is furnished; because electricity is capable of furnishing increased illumination, more light is demanded in every instance.

As a general matter, it may be stated, that cost is no measure of value; the true measure of value is the worth to the consumer, rather than to the producer.

Several years ago, some tables were published, showing the cost of lubrication in a number of cotton mills. Over fifty of these mills were engaged in the manufacture of print cloths; making the same kind of goods; were equipped with similar machinery, and competing in the general market. In some of these mills, the item of lubrication for each pound of cloth produced, was four times as much as in others; and a curious fact may be mentioned in this connection, that of the two mills, where the cost of lubrication was the greatest, one used the most expensive, and the other the cheapest oil of any on the list; the general result indicated that the greatest economy resulted from the judicious use of a good oil.

The merits of electric light, consist in the indirect matters of its value over other methods of lighting, rather than any difference in the cost, as compared with gas or oil. In this connection, we wish to cite a few instances where the worth of the electric light has been of great value to the places where it is in use.

In photography, it has furnished pictures of mines, caves, the interior of the great pyramid and places beyond the reach of sunlight. Photographers have studios in places more convenient of access, and can take sittings independent of time or weather. In one studio in this city, the shadow effects are controlled by giving a slight motion to the arc lamp used to light the room. As the operator has the conditions of illumination wholly within his control, the results are more satisfactory than when variations of light must be allowed for by the artist.

A circular recently issued by a photo-engraving company, informs its patrons that their plates can now be delivered promptly without regard to weather, and, in cases of urgency, work can be prosecuted during the night, as the use of the electric light in photography has rendered them independent of sunlight. Every business man can appreciate the worth of appliances which relieves an establishment from bondage to the whims of the clouds, and permits a continuous operation with all its attendant advantages.

A large machine shop in Connecticut was engaged upon a contract for munitions of war for a South American government. Much time was required at the commencement of the work in the preparation of the necessary special machinery, and it became evident that the completion of the contract would be delayed, and subject the establishment to a heavy forfeiture. The foundry was poorly lighted by windows on two sides, and it was impossible for gas to furnish enough light for finishing the moulds. Three electric lights enabled the work to be prosecuted with despatch, and the contract was fulfilled within the stated time.

It is well known that in those processes of manufacturing, where machinery has developed the sub-division of labor to a great extent, much of the success is due to the stability of a well balanced and continuous organization of the employees; irregularities of attendance, and enfeebled health, diminish the production of that machine, and other things being equal, rob those who attend to subsequent processes of manufacture of a proper share of work. As competition increases, the importance of giving due attention to the healthful surroundings of artisans and employees is receiving attention.

The electric light neither consumes nor heats the air, and thus tends to render the help keen to observe the work which the flood of light renders more clearly visible.

These matters are more noticeable where continuous night work is carried on. The production of a certain mill, engaged in spinning cotton with two sets of employees, increased over ten per cent. after the electric light replaced gas. The conditions were particularly favorable for a strong comparison, for, in addition to the continuous operation of the machinery, the building was low, and unprovided with any system of ventilation, and sickness was so prevalent among the help that their attendance was very irregular, until the electric lights were introduced.

The electric light introduced a new complication in the labor problem in a New England mill, where the weavers struck last winter because they were refused the electric light during the day. The cause of this unusual devotion to electricity was due to the fact, that they were paid by the piece, and soon learned that the sharp shadows of the arc light enabled them to detect a missing thread at once.

The electric light has been of service in tunnelling, and is beginning to be introduced into mines.

In lighting the cavities of the human body, it has extended the field of the surgeon's skill.

In a field of applied science, whose results have proven of especial value to our fisheries, the United States Fish Commission are to use electric lights during the coming Summer to illuminate both the surface and the depth of the sea; and it is expected that this will add even more to the sum of knowledge of marine life than its other researches in the past.

THE CHICAGO EXPOSITION OF RAILWAY APPLIANCES.

THE Exposition of Railway Appliances, which is just opening at Chicago, bids fair to be of great importance in electrical matters. A sufficiently liberal interpretation has been given to the term, "railway appliances," to take in nearly all the important industrial applications of electricity, and, we understand that some of the exhibits of electrical apparatus will be of great interest.

The electric light companies, in particular, are exhibiting their latest improvements in apparatus in actual operation, so that a good opportunity will be afforded for a comparison of the different systems.

The United States Company is exhibiting arc and incandescent lights, and transmission of power; and, in addition to its exhibits, is lighting a large part of the exposition building under contract. The Edison Company is exhibiting incandescent lights. The Brush Company is exhibiting the Brush arc light, and storage battery, and the Swan incandescent light. The Fuller, American, and other companies are exhibiting arc lights.

An electric railway has been constructed under the direction of Mr. S. D. Field, in operating which, as we are informed, a Weston dynamo machine and motor will be used.

We hope to give a more detailed description of these and other interesting exhibits in subsequent issues.

In view of the great improvements which have been made since the Paris exposition, a new series of authoritative tests and measurements seems very desirable. The Chicago exposition furnishes an excellent opportunity for this, which we hope will not be neglected.

—— THE NEW GUION LINER *Oregon*, which is intended to be a faster vessel than the *Alaska*, is to be fitted up with Edison incandescent lamps. The plant will consist of two duplicate 500-light machines and engines.

FRICTIONAL ELECTRICITY IN MILLS.

ONE of the mills of the Evans Imitation Leather Company, at Salem, N. H., was set on fire in a very curious manner, on the 5th of last March. The goods of this company are a contradiction of the old college song, "There's *nothing* like leather," for it is cloth, covered with a preparation which resembles leather.

In the manufacture of this substance, the cloth is carried between rollers beneath the coating mixture, and the surplus is removed with a long scraper. The compound is mixed with naphtha; and, on the date above mentioned, a man was reaching over the covering machine, when the frictional electricity, generated at the rollers, drew sparks from the man's fingers, which ignited the naphtha and destroyed the mill. In the other mills of this company, copper conductors, leading to the earth, were placed at every place where there was a liability of the production of frictional electricity; so that it is now impossible to obtain a spark by placing the knuckles at any belt.

The present process of calendering paper, electrifies it; and the pile of sheets retain the static charge for a long time. Such paper cannot be printed with any facility, as every printer knows to his cost. In printing the calendered sheets of Gregory's seed catalogue, out of ninety thousand sheets that were given to the printer, eighty-one hundred were utterly ruined, and many others defective.

An example of the ability of highly finished paper to retain a static charge, can be seen by unfolding one of the semi-weekly issues of *Bradstreet's* upon a desk, and rubbing it with dry hands briskly from the centre to the edges; if the air is dry, it will then retain its position upon a shellaced door, for a long time.

F. W. Bacon, the veteran mechanical engineer, has written to *Cotton, Wool and Iron*, an account of some interesting experiments which he made with frictional electricity, in the mills of the Boston Manufacturing Company, at Waltham, Mass., in 1839. He states:

"A belt, some fourteen inches wide, running some 1,200 feet per minute, was run from an adjacent building into the weave shop, over the looms. It was soon seen that four pairs of looms, over which the belts passed, were seriously affected. The weavers declared that it destroyed their hair—that it made it 'stand on end"; if a thread broke, it caught at once the belt; that all the dust of the shop accumulated around them, to fall on the webs when the mill stopped. It was impossible to get weavers to run them. The overseer of the room applied to me to help him out of the trouble, having exhausted his own patience in attempting to remedy the evil. I took a $\frac{3}{8}$ inch bar of iron, of sufficient length to cover the width of the belt, drilled holes through it (No. 10 [illegible] [illegible] in apart, inserted *pointed* wires, 2 inches long, fastened [illegible] the proper place, attached a No. 10 iron wire to the bar holding the [illegible] it off some 30 feet to the water pipe. The remedy was [illegible] [illegible] hair fell, the broken threads ditto, and the dust stopped [illegible]. I have used the same thing since, with equal [illegible]

[illegible] has been formed, in London, for the construction [illegible] railway under the Thames, through iron cais- [illegible] by means of a stationary engine, transmitting [illegible] which will run separately, start as filled, and [illegible] minutes in the journey.

[illegible] pneumatic tubes under Broadway, has [illegible] Western Union Telegraph Company, who will [illegible] wires will be carried. Six of these [illegible] Produce Exchange building to Forty-sixth [illegible] Fourth Avenue. Man-holes, four feet [illegible] feet apart, to obviate the necessity of [illegible] making repairs.

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

III.—ENGINES INDIRECTLY CONNECTED, ONLY.

THE CORLISS ENGINE.

DIVIDING engines used in driving dynamo-electric machines into two principal classes—engines driving indirectly through gearing or belting, and engines directly connected to the armatures—we may profitably devote considerable space to the first class. And, although machines of the kind which have come to be distinguished by the appellation "high-speed engines" may be, and often are, indirectly connected, it is proposed to leave the examination of such engines to a later article on directly connected engines, and here to describe only the "drop-cut-off" engines, or those with "detachable valve-gear," which can only drive the armature of the "dynamo" indirectly.

The first drop cut-off introduced, had a form patented by Fred. E. Sickles, in 1841. This engine was first built for mill purposes, by Thurston, Gardner & Co., at Providence, R. I., that firm then holding the Sickles' patents, except that the marine engine business was retained by Sickles. The modern stationary engine was thus introduced, and was soon extensively made known among steam users by its superior performance when competing with the older engines, which were then usually arranged to expand steam about one and a half times by the lap of the single three-ported valve. A few engines were built of a better design, fitted with an independent cut-off valve on the back of the main valve. These two last named engines would, at best, with good boilers use five or six pounds of coal per hour, and per horse-power, where the Sickles valve-gear would bring the consumption down to four.

Regulation was always effected by a governor controlling a throttle valve. This governor was usually a common fly-ball governor, and its deficiency in power and lack of isochronism, the distance of the regulating valve from the engine valves, and the range of motion required in its operation, and the resistance offered by the packing of the steam, altogether, made this combination a very ineffective regulating apparatus. Thurston, Gardner & Co., substituted for this the Pitcher hydraulic regulator and a register valve, which gave a much better regulation; this contrivance was also isochronous, *i. e.*, it was capable of holding the engine at speed, whatever the variation of steam-pressure or of load.

But an immense step in advance of this, then, best practice was made by Geo. H. Corliss, a young Poughkeepsie mechanic, who had exchanged the *rôle* of sewing-machine inventor for that of the inventor of the most famous steam engine that has appeared since the time of Watt. The Corliss engine was patented in 1849, and rapidly came into use, its remarkable economy, when competing with the best existing engines, the peculiar business tactics of its builder, and the rapidly increasing demand for efficient, and especially well regulated, engines, combining to give it a wonderfully rapid introduction.

The engine is an interesting illustration of a machine which is the representative of a peculiar type, each detail of which is especially adapted to its place in that machine, and is characteristically different from the parts which perform the same office in other engines. The leading features of this machine are:

1. The use of four valves—two steam, and two exhaust—so placed as to reduce "clearance" to a minimum.
2. The use of a rotating valve, capable of being cheaply and readily fitted up, of being easily moved, and of being

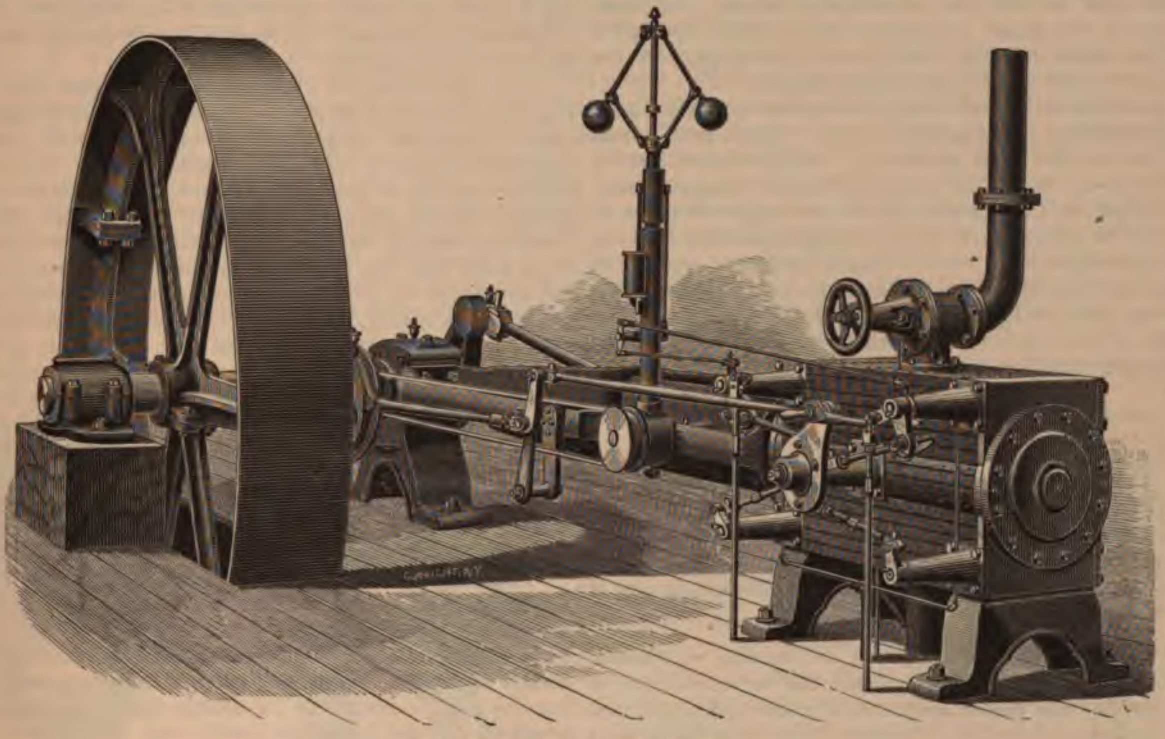
conveniently worked by connections outside the steam spaces.

3. The use of a "wrist-plate," caused to oscillate by a single eccentric, and directly so connected with all four valves that each may be given a rapid opening and closing movement, and held open and nearly still, at either end of its range, by swinging the line of connection nearly into the line between centres, thus permitting nearly a full opening of port to be maintained during an appreciable interval, and a free and complete steam supply and exhaust.

4. A beautifully simple and effective method of detaching the steam valve from the driving mechanism, and of insuring its rapid and certain closure at the proper moment, to produce any desired expansion of steam.

5. A direct connection of the governor, so as to determine the ratio of expansion, while so adjusting the power of the engine to the work to be done, that the variation of speed with changing loads becomes a minimum.

6. Making this latter adjustment in such a way as to throw the least possible work on the regulating mechanism, and thus to give the governor the greatest possible sensitiveness and accuracy of action.



THE HARRIS-CORLISS ENGINE.

7. A form of frame and general design of engine, which gives maximum strength and stiffness, with least cost and weight.

All these features are combined to form a steam engine essentially different, in general and in detail, from the engines contemporary with or succeeding it, except where the latter may properly be classed as Corliss engines. It rarely happens that an inventor succeeds in originating a plan so wholly and so essentially novel; and it is still less frequently the fact, that a peculiarly original device is found superior to all competing machines. In operation, the engine was found to exhibit a remarkable economy of fuel, and a singularly perfect regulation, and to be far more durable and more economical in cost of repairs, on the average, than rival builders supposed possible. It very soon took the leading place in the market.

The inventor established himself at Providence, and put in operation a method of marketing his machine, which was as novel and as successful as the mechanical device itself. He offered to put his engine in place of rival engines, either with a guarantee of a certain saving, and at a stipulated price, or, often, to take as his compensation the actual saving shown on the books in a stated time. This system was eminently satisfactory to the purchaser, both as making him safe against loss, and as giving him some of that confidence in the engine which the maker himself unquestionably possessed. Corliss' work fully justified his claims, and the expenditure of fuel was brought down to between three and four pounds per hour, and per horse-power, according to size and situation of the engine, with occasionally still better figures in condensing engines.

These engines are now built, not only by the Corliss Steam Engine Co., under the eye of the inventor, but by many other builders. It has found its way into every part of the world; and the engineer visiting Europe, will find a pleasure in observing the general adoption of this American invention in every country, and for every purpose. European makers frequently modify the design, but rarely with the desired effect of securing an improvement in cost or efficiency, and frequently with a decidedly contrary result.

Corliss engines are now very frequently adopted in electric lighting, and are always belted to the dynamos. Their excellent regulation is as important a feature in this application, as is their economy in use of steam. When carelessly constructed, they are, of course, likely to prove wasteful and irregular in action. But that these engines can be made to give very perfect uniformity of rotation will be evident, when it is stated that the writer, in testing engines of this class, has found that the variation of speed was so slight as to be practically inappreciable, even when the amount of work thrown on or off, was a very large proportion of that done by the engine when working at its rated power.

One other reason for the success of this engine is unquestionably the comparatively small cost of its construction, where competing with the earlier forms of engine with detachable valve-gear. Its valve-faces, particularly, and their seats, are surfaces of revolution, and they, as well as a large part of the finished work about the engine, being almost wholly lathe-work, the cost of fitting up is comparatively small.

In detail, the engine consists, as shown in the above illustration of one of its standard forms, of a steam-cylinder sustained by any substantial connection with the foundation. The main pillar-block sustains the crank-shaft at the opposite end of the machine, and a strong brace, connecting these two pieces, forms, at the same time, a support for the crosshead guides.

This form of engine-frame, used by Horatio Allen, the veteran president and engineer of the Novelty Iron Works, at a very early date, was adopted by Mr. Corliss, and has been copied from his engines by other builders throughout the world.

The four valves are placed at top and bottom of each end of the cylinder, their rotating stems projecting, and are moved by the "wrist-plate," set usually, as here, at the middle of the cylinder, the valve connections radiating to the four corners, where each is attached to the valve rocking-arm, the exhaust by pin-connections, the steam by a catch, which can be readily "tripped" by the adjustment of a little cam set on the valve-stem, behind the arm. When tripped, the steam valves are closed by a spring in engines now built by Mr. Corliss, and by weights in his earlier engines, and in those of other builders.

The governor is belted from a pulley on the main-shaft, and its oscillations are controlled by a "dash-pot," seen attached to the side of its standard. The governor, having no work to do but to set the tripping-cam, or the equivalent for it adopted by Corliss and others in various designs, is entirely free to adjust itself to the normal position due the speed of the engine, and thus is made perfectly capable of doing the best possible work. Many foreign builders have attached the Porter loaded governor to this engine. The advantage is less obvious here than in engines in which more strength of action is needed.

—— IN RELATION TO A PARAGRAPH in the London *Truth*, which declared that the Edison lamps in the library of the House of Commons went out twice within a period of ten days, Mr. Edison writes to *The Evening Post* to say, that the system used in the House of Commons at the time alluded to was the Swan light.. He says that since his lights have been in use in the House of Commons, there has been no failure on the part of any of them.

—— A CURIOUS INCIDENT is reported as occurring on Siemens' electric railway at Portrush. Owing to the fact that as yet only part of the line is furnished with electric conductors, a steam engine is still used as well as the electric locomotive. A few days ago the steam engine while drawing its load along the line, came to a stand through the accident of bursting a boiler tube. News of the disaster having been sent to the terminus, the stationary dynamo-electric machine which supplies the current was set into action, and the electric locomotive despatched to the rescue. It returned an hour later bringing the disabled steam engine behind it.

—— SEVERAL LOCAL electric lighting companies have lately been organized for supplying the public with arc lights produced by the dynamos and lamps of the *Thomson-Houston system*. Among the most successful of these local companies are those at Lynn, Fall River, Lowell, Fitchburg, Hartford, Utica and Kansas City. The parent company has been known heretofore as *The American Electric Co*, of New Britain, Conn., but the control of the company having passed into the hands of capitalists in Eastern Massachusetts, the name of that company has been changed to *The Thomson-Houston Electric Co.*, and the principal office has been established at Boston. The dynamos and lamps are still manufactured at New Britain, but a factory for their production is shortly to be opened at Lynn, Mass.

THE A, B, C, OF ELECTRICITY.

LIEUT. BRADLEY A. FISKE, U. S. N.

PART I.

THOUGH the advance of electrical science, during the past few years, has been so great that none but specialists have been able to follow it, yet the inventions and discoveries which have been made affect us and our surroundings so intimately, that even those who have had the least time to devote to the subject, cannot but feel a personal interest in all that pertains to it. With many, this interest is merely that which every one feels in things new and strange; while with others, it is aroused by the important commercial position which has suddenly been assumed by electrical companies, and by the practical advantages they offer in the way of lighting streets and houses, and economically furnishing motive power for machinery.

The attention commanded by the subject is shown in the daily press. Scarcely a paper can we peruse without finding a notice of some new invention or discovery, or of the extension of electrical systems to comparatively uncivilized quarters of the globe.

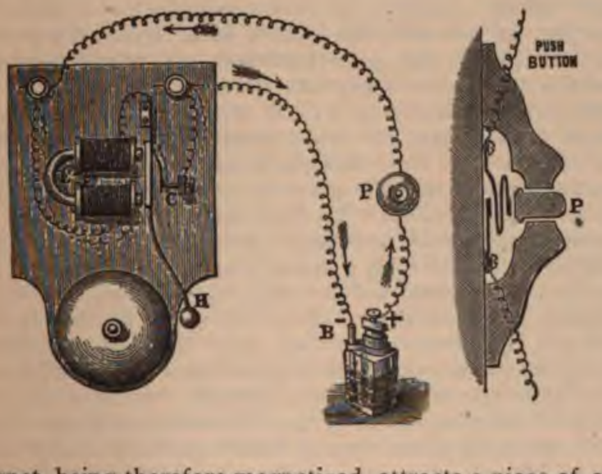
The succession of important inventions has been so rapid as to be bewildering. Hardly had the telegraph become a practical thing, upon an extended scale, when electric lights began to be used in Paris; shortly after, came the announcement of the transmission of speech in the telephone; shortly after, we were told that spoken words had been reproduced by the phonograph; then we heard that electricity had been stored in an accumulator; and now, we are asked to believe that we shall soon see distant objects by electricity, as we now hear distant sounds. Probably the most striking feature of the electrical question is, that as yet, no limit can be seen to the increase of the applications of electricity. Many years ago, a limit could be seen to the power of steam; but nothing like this yet looms up before us, with electricity. Even in the oldest branch of electrical science, that of generating electrical currents, discoveries and inventions are being, almost daily, made, especially in generating currents by heat, that threaten to revolutionize every system now in vogue.

The simplest way of getting an electric current is the well-known method, which we have all tried, of putting a piece of zinc and a piece of copper into a vessel of water, to which a little sulphuric acid has been added, and then joining the metals by a wire. What now ensues, nobody exactly knows; but the zinc is found to be slowly dissolving away—being attacked by the sulphuric acid—and the wire to possess many curious properties, which it did not possess before, and which it ceases to possess as soon as it is removed from the metals. These properties are said to be due to a current of electricity, which flows through the wire from the copper to zinc. Whether such a current flows, or not, has never yet been definitely proved; but the hypothesis is a convenient one, and is now generally adopted, all over the world.

Nearly all of the practical applications of electricity have been made by combining electricity and magnetism; for, as is well known, electricity can produce magnetism in iron, and magnetism can produce electricity in wires. Magnetism is, however, found unaccompanied by any apparent evidences of electricity in the natural lodestone, and in steel which has been magnetized by being rubbed upon a piece of lodestone.

But the practical uses of the steel magnet are very limited; while those of a magnet made by passing currents of electricity around a bar of soft iron, are so many as to defy enumeration. No telegraph sends a message from one place to another, no telephone acts, no electric machine, no electric light, no electric apparatus of any kind, it might almost be said, can operate without a magnet of this kind. Its great usefulness lies in the fact, that its magnetization is completely under the control of the current; for, as soon as the current passes, it becomes a magnet, and as soon as the current ceases, the magnetization ceases. So rapid, in fact, is its action, that a magnet of this kind, called an "electro-magnet," can be magnetized, and demagnetized, hundreds of times in one second.

To make an electro-magnet, all that we have to do, is to take a bar of soft iron, and wrap around it a wire, being careful that the turns of wire do not touch each other. To render this operation easy, wire is manufactured which is covered with a coating of some material like rubber, which does not conduct electricity. On now attaching one end of the wire to a piece of zinc, and the other to a piece of copper, placed in the vessel of acidulated water, a current will immediately pass through the wire, from the copper to the zinc; or, to use the terms ordinarily employed in electrical science, from the positive to the negative pole of the battery. If, now, we place a piece of soft iron in front of the end, or "pole," the soft iron will be instantly attracted, and if free to move, will affix itself hard against the pole. If we then "break the circuit," by removing either wire from the battery, or by breaking the wire, the current will instantly cease, and the soft iron will instantly drop off. The electric bell, which we ring by pressing a button, is a simple application of the electro-magnet. When we press a button on the wall of a room at a hotel, we simply force together two wires, one of which comes from one pole of a battery, while the other comes from the other pole. In other words, we "close the circuit," so that an electric current passes. But one of these wires goes around an electro-magnet, at the hotel office. This electro-magnet, being therefore magnetized, attracts a piece of soft iron placed in front of it, and draws it towards itself. On the other end of this piece of soft iron, which is called the armature, is a clapper, which is near a bell, so that as the armature moves towards the electro-magnet, this clapper strikes the bell. Thus, by pressing a button in our room, we cause a bell to be struck in the office. But the reader will hardly be satisfied with this explanation, for he has noticed, that when he presses the button, the bell does not give out one sound, but emits a jingling sound, as if struck many times. The reason of this is, that a single tap might fail to call attention, whereas, a continuous rattling noise can hardly fail to attract the notice of any one within hearing. The rattling is accomplished by having in the bell a little device—such, that when the armature is attracted towards the electro-magnet, the motion separates two points which were in contact, and through which the current was flowing. As soon as the points are drawn apart, the current is therefore, broken. Being broken, the electro-magnet instantly loses its magnetism, so that it ceases to attract its armature, and the armature is immediately drawn back by a spring. But this motion brings the two points together again, thereby closing the circuit again, which results in again attracting the armature. Thus, the armature automatically makes and breaks the circuit, and is, therefore, attracted towards, and drawn away from, the electro-magnet many times a second; and, therefore, strikes the bell many times a second.



Telegraphing is also an adaptation of the principle of the electro-magnet, in which the operator, in one place (New York, for instance), closes the circuit of a wire which runs from New York to another place (say Chicago), and passes around an electro-magnet at that place; so that, as the operator in New York closes the circuit with his key, the armature in Chicago is attracted, and strikes the electro-magnet with a sharp click. Now, each letter of the alphabet can be signaled, by closing the circuit a certain number of times, and for periods of different durations; so that a practiced ear, on listening to the clicks of the armature, can read each letter as it is made.

The telegraph has now become such an everyday affair, that it is difficult to realize the difficulties put in the way of the early inventors, even by those whose interests it was to promote. It is related, that shortly after the battle of Waterloo, Sir Francis Ronalds invented a system of telegraphy, and referred it to the War Department. This system, though far inferior to those of the present day, was yet a great improvement over the clumsy methods then in vogue, of waving flags and other visible objects. But the war department declined having anything to do with the new invention, saying, "Now that the war is over, telegraphs will be no longer required!"

Of late years, many inventions have been made for sending messages more rapidly than can be done by the hand of a man. In these systems called automatic systems, the sending and receiving are accomplished by machinery. In most of them a long piece of paper tape is perforated with a series of dashes and dots, which correspond to the letters of the message. *B*, for instance, being represented by a dash and three dots (— . . .) would be represented on the tape by a long slit and three holes. To accomplish the perforation rapidly, a perforating machine is used, somewhat similar to a type-writer. The paper tape on which the message is to be prepared, being put in the perforating machine, the operator presses the keys of the machine, in their proper succession; and as each letter is pressed, the corresponding perforation is made in the tape. When the tape has been prepared, it is wound upon a reel. From this reel, it can be rapidly unwound by turning a crank, which winds it upon another reel. In going from one reel to the other, the tape passes over an iron roller to which is attached a wire from one pole of the battery, and under a metal stylus, which is attached to the other pole of the battery. When this stylus rests upon the paper no current can pass, because paper does not conduct electricity. But when a hole or slit passes under the stylus, the stylus drops down and comes into contact with the metal roller, thus making the circuit. It is evident that, when the tape is drawn along at a uniform rate, the current will be made as each round hole and slit pass beneath the stylus, being made for a longer time when a slit passes than when a round hole passes. Now to receive these rapidly succeeding currents, whose duration is inconceivably short, it is clear that we need some exceedingly sensitive device. We find this in a piece of paper soaked in a certain chemical, for when a current passes through it, no matter for how short a time, it stains the paper. In using this to receive a despatch sent by the means just described, the piece of paper tape is rapidly drawn between a metal surface and a stylus, the metal surface being connected to one pole, the stylus to the other. Each time the current is made, therefore, a stain will be left upon the paper tape, and the length of this stain will be proportional to the duration of the current. So that, when a slit passes under the stylus, at the sending end, a long stain will be made upon the receiving tape; and when a round hole passes, a short mark will be made upon the receiving tape. Thus the receiving tape will be marked with the same succession of dots and dashes as was the sending tape.

The operator at the receiving end has now only to read off the message, translate it into ordinary language, and send it to the person for whom it is intended.

In practice more than one message can be sent over one wire at the same time. By the invention of duplex and quadruplex telegraphy, in which we find to a great extent the hand of Edison, as we do in every branch of electrical science, two messages can be sent in one direction at the same time that two other messages are being sent in the other direction, or four messages in all. But the apparatus is too complicated to warrant the attempt to explain it in a general article of this kind.

(*To be continued.*)

NEW YORK ELECTRICAL SOCIETY.

AT the meeting of the New York Electrical Society, May 18th, Mr. Walter P. Phillips described the system of telegraphy invented by himself, known as "Steno-telegraphy." He said:

There is so much confusion, in the telegraphic mind, concerning my devices, that perhaps I may as well explain the objects and aims I have in view.

To make myself understood, I will say, this is an ink writer (holding one of the Phillips' automatic machines in his hand). It is something like the Digney ink writer; something like the Wheatstone; better, I think, than either. The use to which this instrument is put, is to receive contractions, based, primarily, on the abbreviations used by operators, ever since I was a boy, and learned to telegraph, 22 years ago. These contractions—which I have amplified, systematized, and finally developed into a perfect system of short-hand for telegraphic purposes—I call "steno-telegraphy." It differs widely from the old abbreviations, and, where you will find me using "4," for "where," you will also find me employing "T Q," for "the question"; "T F," for "the following," and many other combinations, capable of being quickly committed to memory, of which you probably have never heard. For instance, we say, "3:15 bug aut 12," which means, "At 3:15, the Senate went into executive session, and when the doors were reopened, an adjournment was taken until 12 o'clock to-morrow." Nor is the system in any way confined to congressional matter. In handling the general run of news matter, we are just as clever. "S. S. N." disposes of "Sir Stafford Northcote, Chancellor of the Exchequer," while "U T C" covers "under the circumstances," and "C K X," "committed suicide." Steno-telegraphy will double, and often treble, the capacity of a single wire, a duplex, or a quad. Mr. W. J. Cook, the inimitable "Bif," sent, from Washington to Cincinnati, in 5 hours and 5 minutes, the great speech of Senator Conkling, delivered in front of Cooper Institute, during the Garfield campaign. It consisted of nearly 20,000 words, and took Mr. Conkling more than four hours to deliver it. Mr. Cook made an hourly average of nearly 4,000 words. His time, however, has been beaten by Mr. Walter L. Prentice, who has sent 4,600 words in an hour, and by Mr. Fred N. Bassett. The latter sent from Washington to Chicago between 10.30 P. M. and 3.10 A. M. 21,000 words, two full pages of the *Inter-Ocean*. This was done on one side of a quad, with Washington working with Pittsburg on another, and Chicago with Pittsburgh on another. Two operators copied this matter out, and were clear five minutes after Mr. Bassett sent "good night!" I doubt if two operators could have copied more in the same time from expert sending on a much steadier circuit; and I doubt also, if any two senders could have gotten the matter over two sides of a quad in the time consumed by Mr. Bassett using only one side.

I have never had any difficulty in teaching men to send steno-telegraphy. They become familiar with it, so as to average 3,000 words per hour in a few days; but the modern operator knows very little about tape, and I suppose that there are not more than twenty expert tape readers in the country, outside of those reading the double line characters in the American rapid offices, and those whom the Western Union are now teaching to read the Wheatstone tape. In view of this scarcity of tape men, I reason, that if I could take steno-telegraphy on an embosser, or ordinary Morse register, and run it through a transmitter at a low rate of speed, a sound operator could copy out the contraction in full, and we thus could do away with the ink recorder, and the reading sight instead of sound. I went further than this. I made an automatic which utilizes the Morse talent. I have nothing to do with perforators. I adhere to the Morse register, and with the matrix made by it, I transmit into the line, at any desired rate of speed, from ten words per minute to 200 words per minute. I can work with these slips up to the Wheatstone standard of speed, and can take it either on an ink writer or on the sensitive tape, and I can do, what neither the Wheatstone, nor any other system can do, outside of mine — I can let an operator send, on a local circuit, say 60 messages an hour, and put them over one side of a quad at the rate of 120 per hour, take them on an embosser, and then slow them down on a local circuit to 60, 50, 40, 30, 20, or 10 messages per hour, according to the capacity of the receiver. I have demonstrated that I can send 60 words a minute to Chicago, over one side of a quad, or 3,000 words per hour. If, then, the matter be press, and the sending operator entapes it in my contractions, it can be sent at the rate of from 7,000 to 10,000 words per hour. All this is accomplished without the intervention of the perforator. The work is all to be done by Morse men —done by men trained to read copy, done with a Morse key, and consequently, done in a workmanlike and intelligent manner. If any automatic outside of this one, is ever a success, it will be the Wheatstone, and how many men out of the great army of Morse operators in this country to-day will ever take kindly to punching paper with a pair of toddy sticks? In England, where caste pervades everything, it is easy to club men into doing anything; and I understand that the Wheatstone has there been a great success. But the American operator has his own notion about the proper use of toddy sticks, and thus far he has not taken kindly to automatics. Without the co-operation of the Morse men, any new system of telegraphy must fail, and I have endeavored to build up a system calculated to save wires and employ the men who have devoted their lives to learning the business, and whose views, prejudices and peculiarities must be taken into account by any man who aims to improve on the original Morse method.

Mr. Phillips then ran some tape, already prepared, through one of his transmitters at various speeds, ranging from 10 words to 100 words per minute. The characters were reproduced on the sounder in circuit with great precision. About 75 words per minute seemed to be the limit of possibility to read by ear. Much merriment was created by the story told by the sounder. The subject was, so to speak, a bird's-eye view of that famous press circuit in days gone by, No. 4 East.

At the conclusion of Mr. Phillips' remarks, Mr. Dan. Boyd, Managing Director of the Electrical Portable Battery and Gas Igniting Company, of Manchester, England, was introduced. He exhibited some novelties in induction coils, portable gas igniters, call bells, etc., and imparted some valuable information to those present. The company he represents use soft iron wire, as well as copper, in the construction of helices. The wire is used bare, and the insulation of the convolutions is effected by winding with the wire a fine cotton thread, which, of course, insulates every convolution from the ones next. Economy of space is the advantage claimed for this method.

Mr. Boyd also exhibited a miniature electric light as a scarf pin. The battery, supplying the current, is so compact that it can be carried in the vest pocket. The light is powerful enough to enable the wearer to read the finest print at ordinary reading distance. Mr. Boyd, at the conclusion of his remarks, presented the society with an electrical portable gas lighter.

The circulating library of the society was inaugurated at this meeting, and it is predicted and hoped that it will be the means of largely increasing its membership and popularity.

OUR PARIS CORRESPONDENCE.

PARIS, May 12th, 1883.

IT was only the following day after the experiments, carried on last February, at the station of the *Chemin de fer du Nord*, with the system of electric transmission of power advocated by M. Marcel Deprez, that we explained in these columns the reasons which made us doubt of their success. Since that time, an attempt has been made to create a certain amount of excitement about this alleged discovery. M. Marcel Deprez has been placed upon a pedestal, the Académie des Sciences has showered the most flattering encomiums upon him, and the government has nominated him officer of the Legion of Honor. It is seldom that we find a *savant* reaping the fruits of his discoveries during his lifetime, and we shall, therefore, not attempt to criticise this rather factitious enthusiasm, but on the sole condition that it is disinterested—a matter which we shall learn some day or other. Still, as the reader will not fail to find an absolute contradiction between my personal views and those of the report of the Académie des Sciences, I think it my duty to offer a few remarks as to the way in which the official committee looked at this problem of the electric transmission of power.

When M. Trèsca was invited to make experiments with the apparatus of M. Deprez, he confined himself to stating some industrial results, so as to seem to explain certain divergencies between theory and practice. He passed justice on the exaggerations that prevailed in the beginning, and came to the conclusion that the power received represented only about one-third of that spent.

The committee, which was composed of Messrs. Bertrand, Tresca, de Freycinet, de Lesseps, and Cornu, did not think proper to place themselves on this ground, but wanted to display science, and to prove (what no one doubted) their competency in such matters. They brought up calculations, analyzed all the phenomena to the minutest degree, and, amidst the scientific apparatus, they completely lost sight of the interesting side of the question.

It is of small importance whether the electric transmission of power to a distance was first accomplished by Faraday or not, by producing deviations of the needle of a galvanometer by introducing the induction magnet in the inducted coil. This cannot be regarded in any way as an instance of the transmission of power to a distance, for, at this rate, the mariners' compass might be cited as ante-dating Faraday's experiments. The problem that now excites electricians, and the solution of which would be so important to industry, consists in the transmission of great powers to a considerable distance. When the utilization of the Falls of Niagara is spoken of, it is not for the purpose of running a sewing machine; but the members of the Académie des Sciences do not seem to have considered that the whole difficulty lay in the measure of the power received, and in the distance. They implied that the returns stated by them were absolute, and that we might infer, from the fact of four or five horse-power having been sent for a few minutes to a distance of some eight miles, that 500 horse-power might be transmitted sixty miles by a suitable modification of the machines. It would not be out of the question, then, to ascertain whether there was not a limit to these transmissions by electric machines, but the experiments have yet to be made. The committee indicated the three great principles of the question: the *transport to a long distance of a considerable power in advantageous conditions of cost.* They were kind enough to believe that the first two conditions had been satisfied, although the distance did not exceed eight miles, and the effort received 4.44 horses. As to the last point, not having any precise data, they thought it best to declare that the return was of only secondary importance, as, generally, forces had to be employed that were unutilizable by the distance from their source.

A manufacturer would not be satisfied with such a statement. The whole future of this new application of electricity depends on the value of the produce—that is to say, on the proportion of work received on the generator to the work paid out on the receiver. The fitting up the hydraulic works, the number of machines, and their power, the number of conductors and their diameter, and all other matters pertaining to the cost and the power transmitted, are closely connected with the return. It is, therefore, simply begging the question to write "However small may be the proportions utilized, provided it is cheap, the result will be advantageous."

We will not analyze the report of M. Cornu here, but it can be seen from this one remark, that it is conceived from a purely theoretical standpoint. In that case the labors of M. Marcel Deprez could be unreservedly commended, and the Académie des Sciences, which seems to have known as much about them as of those of Mr. Smith of Oxford, the *post mortem* laureate of the mathematical prize, took advantage of the opportunity to make up for the neglect. During the past eighteen months all the calculations referring to electric transmission of power have been published in every language; to cite only a few of the best known names, Dr. Froelich in Germany, and Mr. Hopkinson in England, have written on the subject, and contributed severally to the popularization of the idea, which was officially announced, for the first time at the International Congress of Electricians in Paris, in 1881.

Nobody at present thinks of disputing the theoretical truth of it, but lengthy experiments must be made before a correct idea can be formed of the importance of this "industrial revolution" as it has been too hastily dubbed. It seems to us that M. M. Deprez has entered on a wrong path in trying to prove too much at once. The predilection he has for a galvanized wire conductor of 4 millimetres (0.157 inches) diameter, entails a considerable increase of resistance in the circuit, and has an injurious influence on the produce.

Copper wires, although dear, must be employed for long distances. As to fine wire machines designed to give a great deal of electro-motive power with feeble intensity, we believe that they must be modified so as not to require velocities of 1,000 or 1,500 revolutions—as such are not without objection. Experiments to this end are now being made in Paris, and although there has not been such noise made about them as about those of M. M. Deprez, they have been already productive of some remarkable results. The electric company that has been quietly conducting investigations for the past eighteen months has now in fact, definitive models of machines that will transmit from 3 to 30 horse-power several kilometres. It will, doubtless, be seen working at the coming electrical exhibition of Vienna, and that city, where Gramme first exhibited the transport of power, will be the first to judge of the progress made in this line within the past ten years.

There has not been much talk about electric companies for some months past—at least as much as there used to be. They are engaged in strengthening their position, and do not need the publicity of which they made a somewhat too liberal use in the beginning. The advantages of electricity are being more appreciated, however, and its applications are increasing slowly but steadily. Inventors are growing tired of devising dynamo or magneto-electric machines, and regulators. The first patent for the Gramme machines will become public property in a few months, and there is no lack of electric lamps that will work well if carefully constructed.

It is becoming more difficult, therefore, to dispose of patents, or even working licenses. Such financial considerations as these, have dulled the imaginative faculties, and explain the attention and experiments that have now been turned towards the battery. We have already referred to this subject, and we believe it interesting to make some additional remarks at present.

The *Comptoir d' Escompte*, of Paris, which was lighted, during a part of the winter, by both arc and incandescent lamps fed by batteries, is now about giving up the system, owing to its exorbitant cost. The fitting up of the batteries cost more than 300,000 francs, and the working expenses have been in proportion to this figure. It was believed that the batteries would do away with the use of gas and engines, but a gas motor had to be used, and the question is, why not have adopted the electric machines from the outset.

A great many errors have lately been published with regard to the bi-chromate of potash battery of M. Trouve. Mr. Hospitalier shows, by figures in a letter to the *Société Francaise de Physique*, what little economy there can be in this system of lighting. The following is the outlay to obtain one-horse power for an hour, and maintain six incandescent lamps at a luminous intensity of 16 candles:

Wrought zinc plates, - - -	1,460	grams.
Bi-chromate of potash, - -	2,400	"
Commercial sulphuric acid. -	7,200	"

The zincs of the battery are amalgamated, and it may be safely assumed that they cost one franc per kilo, or 1 fr. 40c.; the bi-chromate of potash comes to 3 fr., 60c.; and the sulphuric acid (0.20c. per kilo) to 1 fr. 44c.; giving a total of 6 fr., 50c., or somewhat more than one franc per hour, and per lamp. Nor is the wages of the person in charge included. It is necessary to state that the battery can not be left neglected during several hours; the zinc must be immersed deeper at the end of an hour and a half, so as to maintain a steady current, and this operation must be frequently repeated to the last. The current always decreases after four hours' running, falling from eight to five ampéres, and is then no longer sufficient.

The bi-chromate of potash battery is, therefore, only adapted for illuminations *de luxe*, and even then on condition that they be not of long duration. On the other hand, gas, with proper burners and glass chimneys, will give an illuminating power of two carcels (16 candles), with a consumption of 180 to 200 litres, and will cost only 36 centimes for a light quite as good as the six incandescent lamps, and minus all the trouble of the battery.

In fact, incandescent electric lighting cannot compete with gas, except in establishments where the motive power is at hand. In that case, some fifteen or twenty lamps, of 8 candles, can be put up at a cost of 1,200 francs, and the cost will not exceed two centimes per lamp per hour. In the paper mill, near Grenoble, and in the workshop of M. Lazare Weiller, at Angoulême, lamps have been put in under these conditions, and have proved perfectly satisfactory.

The first plan for supplying electric light and power in cities, has been submitted to the city councils of Nantua and Bellegarde, by M. Emile Reynier. These cities have been selected, owing to the water power in their vicinity, the possibility of using ærial conductors, and the small extent of the cities themselves.

But this is an *ensemble* of favorable conditions that is rare to find in this country. In applying for a concession M. Reynier placed the price for the city for 1000 kilogrammetres at *one tenth* of one centime—or 27 centimes per horse-power of 75 kilogrammetres, and at double this (54 cent) for private parties. The consumption would be calculated by a metre, constituted by an electro-chemical bath. Under these circumstances, a light equal to one carcel (8 candles), would cost with the vacuum incandescent lamps, 2 centimes per hour for the municipality, and 4 centimes for private parties. The contractor confines himself to selling electric energy—and not busying himself with the question of its use either for lighting or work.

It is likely that accumulators, charged during the day, will have to be used to insure regularity of service. It has to be seen likewise, whether the counter or metre will be placed before or after the accumulators, for on its position will depend the rate finally paid by the consumer. The carrying out of this project will be looked forward to with interest by electricians.

Since the applications of electric light have become so numerous, the want of improving the photometric methods has become urgent; and it is especially necessary to have a luminous standard that will allow of a reliable comparison with the light furnished by gas. The question was discussed at the International Electrical Exhibition of Paris, in 1881, but it was not settled, nothing more being done than to recommend the use of the Carcel lamp according to the rules of Messrs. Dumas and Regnault. The conference of electricians that met in Paris in 1882, recommend for a luminous standard the surface of 1 square centimetre of platina in fusion. M. Violle has made some very interesting experiments on the radiation of silver in fusion, and intends to follow them up with some on platina. But, whatever may be decided on by the committee, the process will be too delicate of application to suit industrial purposes.

It is likely that each country will want—were it only through *amour propre*—to keep its own standard. France, the carcel lamp; England, the spermaceti candle; Germany the paraffine candle, &c. It would be, therefore, of the greatest benefit to determine the relative values of the various types of light, since the luminous intensities of the electric light are expressed by different figures in the various countries. A well-known engineer, connected with the gas industry, M. Mounier, has carried on a most complete set of experiments to this end. He compared the English spermaceti candles, burning under the same conditions as used in photometric tests for London gas, with the Carcel lamp; and also, with this latter, the German paraffine candle as adopted by the German gas companies; and the stearine candle as used in the official gas tests in Munich. He finally compared with the Carcel the ordinary candle called *Etoile*, or star, of which frequent mention is made in the contracts between French municipalities and the gas companies.

He found that the normal Carcel lamp, using 42 grams of colza oil per hour, corresponds to

8.3 English spermaceti candles,
7.5 German paraffine candles,
6.5 Munich stearine candles,
7.4 "Etoile" stearine candles, of 5 to the package,
7.6 "Etoile" stearine candles, of 6 to the package.

To show how annoying such variations are, it will be sufficient to say, that the gas, of which 105 litres in Paris would be equal to the carcel, would be equivalent to 13.5 candles according to English calculation, and 14.5 candles according to the Berlin standard.

It would be a great benefit, therefore, to the lighting interest in general, to have an international standard altogether independent of the Carcel lamp and the candle, with the numerous errors connected with them. Mr. Methven and Mr. Vernon Harcourt have been trying to find a solution to the delicate problem. According to M. Mounier, the arrangements suggested by Mr. Methven do not give sufficiently steady results for their adoption, but the use of carburetted air by means of Volatile carburet of hydrogen extracted from petroleum, and with a proper burner, as indicated by Mr. Vernon Harcourt, would fulfil every requirement. It is advisable, therefore, to have an understanding between the English, French and German gas companies to test this last named standard thoroughly, and to recommend its adoption. The American gas companies who have been enabled to appreciate the skillful experiments of Mr. V. Harcourt, will not remain indifferent to such a reform, and thus an international standard could be created which would answer until the *savants* agree as to the selection of the luminous source.

PH. DELAHAYE.

MUTUAL DISTRICT MESSENGER COMPANY OF BOSTON.

AT the annual meeting of this company, held at Boston, Saturday, May 19th, the number of directors was increased from five to nine, and the old board of the Mutual District Company of Boston re-elected: James M. Prendergast, of Francis E. Bacon & Co.; Parker C. Chandler; Henry W. Pope, of New York; D J. Hern, Supt. of M. U. Tel. Co.; Allen S. Weeks, of Geo. Wm. Ballou & Co.; and four nominated by the Western Union Telegraph Company, as their representatives on the board, were also elected: Frederick L. Ames, a director in the Western Union; D. H. Bates, Vice-President of the Western Union; W. C. Humstone, and C. A. Tinker, Superintendents of the Western Union.

Mr. H. W. Pope resigns the general management, which be has held since the organization of the Mutual Company, and is succeeded by Mr. D. J. Hern. The contract for the exclusive collection and delivery of telegrams of the Western Union Telegraph Company in the city of Boston, covering a period of ten years, was executed.

The new company will immediately proceed to develop and extend its system by opening new offices and consolidating others.

The capitalization of the company, under the new arrangement, is $250,000, $100,000 of which goes to purchase the old company, and to secure the ten year contract; and $50,000 in the treasury, to develop and increase the plant of the company. The treasury stock is to be disposed of at par to the stockholders.

ON THE MIXTURE OF SIGNALS IN TELEPHONIC SYSTEMS.

BY M. G. ESSIG, IN THE *Journal Telegraphique de Berne*.

I EXPRESSED my opinion in a previous article, that the part of a telephonic system, which by its nature, position and functions, combines the elements that engenders mixtures, is the network of conducting wires which are animated by the influence of terrestrial magnetism, and by the effect of the continuous shocks which they undergo. I drew the conclusion that variations of magnetic intensity are produced by the working of the telephones, not only in the apparatuses themselves, but also in the conducting wire which connects them, and that these variations are transmitted by magnetic induction, from one conducting wire to the other wires in the network, and, consequently, put in activity the apparatuses served by these latter. Although experiments would seem to indorse this explanation of the phenomenon, especially in so far, as the "mingling" is perceptible at the central office and the extreme stations of the telephonic line, yet this forms no proof that the magnetism of the conducting wires is the principal cause of the phenomenon. I will endeavor to demonstrate this by an instance from a public line of the German network, which would seem to prove that the cause must be attributed more to the way in which the central bureau is fitted up, than to the conducting wires. For the sake of clearness, I shall, first of all, describe the arrangement of the central office.

The lines joining the telephonic stations with the central office, terminate in the latter in the electro-magnets. The current of the pile that is emitted by a station in the conducting line, traverses the spires of one of these electro-magnets, excites the attraction of the armature, and causes a tongue to fall, which gives an audible and visible signal in the central office. To enable the employé to receive the calls of the subscribers at any time, it is so arranged that one electro-magnet, or both, are continually interpolated in the circuit, even when two stations that are connected together at the central office, correspond between one another. If, in order to understand this phenomenon, we compare the construction of this apparatus (the Siemens' telephones are used for transmission and reception) with that of a tongued electro-magnet, we shall find that the principal organs are alike, and as a consequence of this conformity, the same causes will produce the same effects on both. Now, if the telephone and the electro-magnet are interpolated in one and the same circuit, we shall have, under the influence of the telephonic action, identical effects on the two apparatuses with respect to the magnetic condition, and, in fact, the words that are articulated in the telephone should be immediately perceptible in the tongued electro-magnet.* But the effects produced by the telephonic working of a line, are not restricted to the apparatus interpolated in that line. On the contrary, they are transmitted by the effect of magnetic induction, from the electro-magnet in the central office—on which they are directly produced—to the other electro-magnets. But those of the latter that are interpolated in a line, communicate them in turn to the telephonic stations where the receivers are put, more or less inaction, according to the local conditions.

According to this idea of the phenomenon of the mixture of signals in the receivers, and of which it is difficult to contest the theoretical truth, this mixing must be attributed to the method in which the central bureau is fitted up—that is, to the reciprocal action of tongued electro-magnets. Technical science must, therefore, find one of the following solutions:

"Either to take measures to deaden the effect of such influence to such an extent, that it will be no longer detrimental to the working of the system; or to make such a selection and arrangement of the plant, that its working will cease to be a cause of disturbance."

The disturbing effects of the magnetic induction on the receivers of the telephonic stations might be deadened, to a certain extent, by making use of a carbon transmitter, and having a telephone without magnet or iron membrane for signal receiver. It is doubtful, however, whether a successful result could be thus obtained; if these mixings are to be completely done away with, then we must also get rid of the electro-magnets and, with them, the tongues in the central office, and have other devices for calls that will not be, in themselves, causes of mixture.

An arrangement by which the calls of subscribers would be re-produced in the central office by means of electric light, and without any aid of electro-magnets, might prove a solution of the problem.

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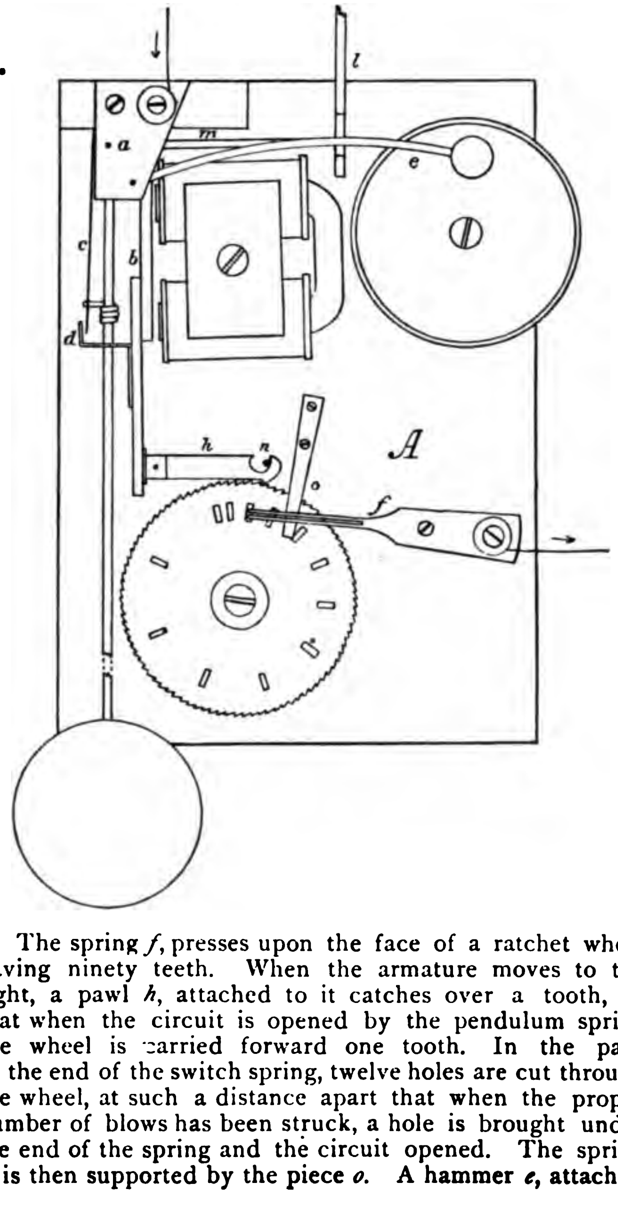
* The question whether the ear is sufficiently sensitive to perceive this, need not be considered here, for the contrary phenomenon, viz.: that words pronounced above an electro-magnet, and even a conversation in the central office, may be heard at the end station, is a well-known fact.

AN ELECTRIC HOUR STRIKER.

To the Editor of the Electrician:

I SEND this description of an electric hour striker after a successful trial of three months. It is a clock attachment set in motion every hour by a cam on the centre arbor, in the same way as a striking train, for which it is a substitute. The number of strokes is regulated by an automatic switch, and the circuit closer is a pendulum; the whole being arranged as follows upon a board (see diagram) *A*.

The pendulum is hung upon an ordinary clock arbor, which is pivoted at *a;* it is about ten inches long. By its side upon another arbor hangs the armature *b*, of an electro-magnet. To the pendulum arbor is fastened a piece of watch spring *c*, which is so arranged as to come in contact with an insulated pin *d*, attached to the armature, when the pendulum swings to the left. By this motion the circuit is closed, and the pin on the armature gives an impulse to the pendulum towards the right by means of the spring. The spring now moves away from the pin and the circuit is opened again. In this way the circuit is closed once every second until opened in another place by the switch.



The spring *f*, presses upon the face of a ratchet wheel having ninety teeth. When the armature moves to the right, a pawl *h*, attached to it catches over a tooth, so that when the circuit is opened by the pendulum spring the wheel is carried forward one tooth. In the path of the end of the switch spring, twelve holes are cut through the wheel, at such a distance apart that when the proper number of blows has been struck, a hole is brought under the end of the spring and the circuit opened. The spring *f*, is then supported by the piece *o*. A hammer *e*, attached to the armature arbor strikes upon a bell; its weight is sufficient to carry the armature with its attachments against the stop *n*, besides turning the ratchet wheel. I have omitted in the diagram the stop which prevents the wheel moving more than one tooth at a time. The current passes through the apparatus from the pendulum spring to the pin upon the armature, thence through the electro-magnet to the ratchet wheel, and out by the switch spring; the different parts being suitably insulated. Electric tap-bells can be placed in the same circuit with the hour striker and the blows repeated upon them Three cells of Leclanché are sufficient to work the apparatus and one tap bell, at a distance of seventy-five feet.

During the ten minutes just before each hour, the clock raises the rod *l;* a notch in this rod engages both the arm *m*, attached to the pendulum arbor, and the hammer wire. In this way it carries the pendulum and also the armature towards the right, the latter hooking its pawl over a tooth of the wheel. At the hour both are let go. The armature carries the wheel forward one tooth, and closes the circuit at the switch. The pendulum then closes the circuit at the armature pin, and the first blow is struck. After the last blow, the pendulum spring strikes the pin two or three times before it comes to rest; but, since the switch is open, no blows are struck upon the bells.

FRED. W. STONE.

SOMERVILLE, MASS., May, 1883.

To the Editor of the Electrician.

IN an excellent article upon "The Prospects of Electric Lighting," in your April number, you say: "The most serious obstacle to the economical generation of electricity by dynamo-machines, is the extremely low efficiency of the steam engine as a means of converting heat into mechanical work." This is perfectly true; but it does not seem to be well understood by practical men, and your article does not touch upon the fact, that this low efficiency is not chargeable so much to imperfections of the engine as to natural conditions, which render a large portion of the loss inevitable, even in a perfect engine.

In the science of thermo-dynamics, it is demonstrated as clearly and rigidly as any physical law can be, that in the conversion of heat into mechanical work, a certain proportion of the heat taken from the source must, from the nature of things, be given up by the engine as heat to the refrigerator or condenser. The heat which even a perfect engine must reject unused, is to the heat that is received, as the temperature of the refrigerator, upon the absolute scale, is to the temperature of the source. To illustrate: Suppose a condensing engine, working with a boiler pressure of 80 lbs. per square inch, corresponding to a temperature of the source of 310° Fah., and having a condenser maintained at a temperature of 80° by the same scale; these temperatures, upon the absolute scale, are, respectively, 770° and 539°. Now, according to the law of thermodynamics, this engine, even if perfect, must give up to its condenser $\frac{539}{770}$ of the heat it receives from the boiler. It can, therefore, convert into work only $\frac{231}{770}$, or thirty per cent., of the heat it receives. An engine, therefore, which, under the conditions assumed above, converts into work eighteen per cent. of the heat given it, has an efficiency of sixty per cent., since it performs $\frac{18}{30}$ as much work as could a perfect engine. In the best steam boilers, probably twenty-five per cent. of the heat is lost in the furnace, leaving only seventy-five per cent. available by the engine; of this, under the conditions assumed above, only thirty per cent., or 22½ per cent. of the whole, can, in the nature of things, be converted into work. If, then, the engine actually converts into work eighteen per cent.

of the entire heat generated in the furnace, its own efficiency, considered apart from the boiler, is $\frac{18}{22.5}$, or eighty per cent. I believe our best engines are giving nearly, if not quite, this percentage of the work obtainable from heat under the practical conditions of working, and they are, therefore, not such very inefficient machines.

In saying that the efficiency of an engine is sixty or eighty per cent., of course the word is not used in its usual signification, as the ratio of work performed to the mechanical equivalent of the heat used, but as the ratio of work performed to the work which could be performed by a perfect engine. It seems to me proper to use the word efficiency in the latter sense when reference is had to the imperfections of the engine.

The same law of thermo-dynamics applies to the conversion of heat into electric energy. Indeed, in any conversion of heat into other forms of energy, under the conditions that exist here on the earth, nature demands that the larger share of the heat put into a machine shall be given up as heat to the cooler bodies that surround it. The conversion of heat into electric energy, directly, can, therefore, save only a small part of the loss that now occurs. But if some way can be discovered of converting the chemical energy of fuel into electric energy, without first producing heat, it will be possible to obtain from a pound of coal four or five times the energy now available by our best steam engines. What we must look for, to stop this great waste of energy to which we are now obliged to submit, is the discovery of some solvent for carbon, or some means by which coal can be used, in the place of zinc, in our galvanic batteries.

When we can shovel coal into a galvanic cell, and see it gradually waste away, producing electric energy, and not heat, the steam engine will pass out of existence; grates, stoves, and furnaces will be banished from our houses; gas for lighting will be forgotten, and the life of our coal fields will be lengthened five times. Who shall make the great discovery?

W. A. A.

ITHACA, N. Y., May 15, 1883.

CERTAIN magneto-electric machines are reversible; that is, a current from one will run a similar machine in the reverse direction. It does not follow that the second machine becomes an economical electric engine. I compare a second magneto-electric machine to a water wheel, driven in its opposite direction, used for a pump.

I wish some one would make the following experiment, and publish the result: The electric engine should be partially made on Page's plan, using an iron core, which is attracted into a hollow helix. The latter should be surrounded by an iron tube. The core and tube are attracted in the direction of the helix's length. The resistance of the electric engine's coils should be equal that of the coils in the magneto-electric machine. As the machines are near each other, the resistance of the connecting wires is not counted. Can we get from the electric engine more than 100 per cent. of the power applied to the magneto-electric machine? The engine may yield sufficient energy to drive the magneto-electric machine by a belt, after said machine has been started by any motive power, the latter being shut off when the machine has been set running. This would be perpetual motion.

JAMES ASHER,
Kleinburg, Ont.

May 12, 1883.

—— THERE ARE SOME four hundred applications for improvements in electrical devices waiting examination and report at the patent office.

A DEFENCE OF GAS.

NEW YORK, May 18th, 1883.

Mr. Editor:

ELECTRIC light does not increase the temperature, nor vitiate the atmosphere; this radical defect is not shared in by gas, which may ever be relied upon as the relentless enemy of pure fresh air. During the summer months this fact is particularly noticeable, and can be vouched for by myriads of unfortunates, who have to work by gas light. Their offices resemble Turkish baths; clothing is a burden to the flesh; and a state of perpetual perspiration their happy lot. No fuel is required where they labor, for gas is an admirable substitute; it is, indeed, their warmest friend. Electric light, on the other hand, wherever used, preserves a healthful, equable temperature.

Electric light dispenses with many of the ills to which gas-lit humanity is subject; it burns steadily without a perceptible tremor, and sheds a soft and refreshing light. Shortsightedness is not engendered by its use, and headaches are unknown in its neighborhood.

Visit any large office where gas is constantly used, and you will be charmed with the variety of spectacles worn on all sides; in fact, gas cannot be relished unless gazed at through goggles; the naked eye is dazzled, and fails to appreciate its never-ending flicker and dance.

There is something extremely sensational about gas that electric light cannot lay claim to. Almost daily, the papers recount the experience of country folks, who, visiting the city, are for the first time on familiar terms with gas in their bedrooms. Retiring for the night, in all innocence, they not infrequently blow out the light, and are fortunate, indeed, if they are awakened on this side of eternity, in the morning.

Electric light here again suffers by comparison, for even the rural visitor, though he have the lungs of Boreas, is unable to blow out electric light; he can rid himself of its presence only by turning off the key which regulates the current.

Electric light is eminently safe to use, and the public encounter no danger from it, whether in bedroom, public building, steamboat or rail car. Gas, however, rejoices in a peculiar and uncontrollable power; its advantage in this respect can be often noted in explosions, when invariably human lives are forced to admit, with their last breath, its terrific power.

Gas evinces a decided partiality for certain professions and trades. Where is the householder bold enough to deny that many a time, and oft, he has been annoyed by escaping gas, and who will assert that the plumber is not in mysterious collusion with the plague, to which he owes his very livelihood.

Remove gas, and substitute electric light, and spectacle makers and oculists will fly the country or starve.

Ask your doctor, how much of his practice he owes to this health-destroying agency, and he will plead, you are having a gas(tly) joke at his expense.

There is not an hospital throughout the length and breadth of the land, but will raise its feverish voice against gas, and many a cot contains sad evidence of its deadly influence.

L. K. O.

NEW YORK, May 17, 1883.

Messrs. Williams & Co.:

Gents—In the ELECTRICIAN, you give our capital $250,000. It is $1,000,000.

Yours truly,
THE STANDARD E. L. CO.

Our information was derived from an official source, which gave the last annual report of the companies.—ED.

ELECTRIC STORMS.

To the Editors of The Electrician:

GENTLEMEN—It may interest some of your readers, to hear the result of a few rough observations made upon the telephone lines of the Westchester Company, at Yonkers, N. Y., during the famous electrical disturbance of November 17th and 18th, 1882. Although the matter has been fully discussed by the electrical engineers, both here and abroad, yet it is quite impossible to collect too many facts concerning these, as yet, unexplained phenomena. Therefore, I present these to you, in hopes they may be worth considering. Owing to the scarcity of reliable statistics, it is impossible to say whether these so-called earth currents, or electric waves, which envelop, at times, the entire globe, are due to the direct action of the sun, considered as a highly electrified and electricity producing body, or indirectly by causing atmospheric disturbances upon the earth's surface. The instruments used at Yonkers were: a rude galvanometer, consisting of a compass, mounted in a coil of twelve ohms' resistance, and having a diameter of 13 inches, and a common Bell telephone and transmitter. The first indications of an electric storm were on the morning of November 17th, 1882, at 4:30 A. M.; the operator noticing the annunciator's falling, sometimes all at once, as if by lightning, and at others singly, as if only one line at a time was charged with a current. The first observations were made upon a trunk line, six miles in length, running four miles East North-east, then two miles South and East from Yonkers. This wire was selected because the current upon it seemed to be much stronger than upon the others. The above galvanometer was inserted between the line and the switchboard of the Yonkers exchange. At once it indicated a current, giving a deflection of 150°, traversing the line from West to East. In 68 seconds it reversed its direction, giving a deflection of 150°, with a current from E. to W. These alternating currents continued to pass over this line for many hours, during which time a telephone and transmitter were thrown into circuit, the telephone being held to the ear, while the observations were read off from the galvanometer, to ascertain whether these reversals had any effect upon the telephonic condition of this wire. This wire is always a noisy one, passing, as it does, for a short distance, near telegraphic and other battery lines, and also is disturbed by earth currents, and "induction."

The following facts were established, by a large number of observations: 1st. That when the change in the direction of the current occurred, no sound was produced upon the telephone, other than those above mentioned; 2d. [illegible] the deflection, no matter how great, indicated a current flowing from West to East, no change, other than a [illegible] augmentation of the usual sound, was produced. [illegible] exception, whenever the galvanometer indicated a current passing from East to West, with a deflection of [illegible] sounds ceased, and not only was the line entirely free from the usual sounds, but was absolutely silent, [illegible] conversation could be carried on with the Mount [illegible] (during this period of silence) with very great [illegible] articulation being much clearer than at ordinary [illegible]

[illegible] with a deflection of 150°, indicating a current from West to East, and the line in a noisy condition, the [illegible] would slowly swing back to zero, then over the other [illegible] indicating a current, in the reverse direction, of 120°. [illegible] point the noise would begin to lessen, and continue [illegible] was reached, when the line, as we have [illegible] became perfectly silent.

This strong easterly current seemed to have the effect of neutralizing all the minor intermittent currents common to this line. If this were due solely to a strong current upon the wire, it would seem possible to produce a like effect by the use of batteries; but, thus far, all such experiments have failed. Thus, it seems as if this silence must be due to a state of uniformity in the electrical condition of the earth and atmosphere in the neighborhood of the entire length of this line, and to a state of temporary equilibrium, only possible under the peculiar conditions produced by an electric wave of vast magnitude, or—as actually does occur a few times a year (generally at night), when a state of silence upon telephone wires is produced—probably resulting from a much more local cause than the storm of November 17th.

This disturbance was not continuous in its effect upon the telephone wires of Westchester county. Beginning on November 17th, at 4:30 A. M., it steadily increased in force until 10 A. M., when it reached its maximum of strength. Then it began to decrease in force until 1:30 P. M., when it disappeared until 7:30 P. M., when it again became quite violent, lasting until 2 A. M. on November 19th.

The area of which we are speaking, is a tract of country extending 32 miles north of New York city, and lying between the Hudson and East Rivers, and Long Island Sound, and having an easterly and westerly wire length of 7 miles. Similar observations were made upon other wires running in all directions, but in no case was the force as great as upon the easterly and westerly wire of 6 miles in length; neither was the production of silence so marked as upon this wire. The next strongest currents were found upon a line, 16 miles long, running due North from Yonkers. The reversals upon these lines occurred sometimes rapidly, and at others very slowly, and, in almost all cases, the needle moved spasmodically, as if the changes in force and direction occurred by pulsations. In all cases, the lines running East and West gave an opposite deflection from those running North and South, all changing their current direction simultaneously. In speaking of these currents, the terms + and — have been avoided, because, as has just been shown by Mr. W. H. Preece, F. R. S., unless some standard, other than the current direction of a battery, be used in observing these "earth currents"—such as the polarity of a current traversing the meridian of Greenwich from South to North,—it is impossible to distinguish a + current, passing from a point of high potential to one of low, through wires running in a parallel direction, or, in fact, in any direction by which they make an angle less than a right angle with each other—from a — current; for, in such a case, the currents appear to move in opposite directions upon the two wires. We simply cite this as an example of an extreme case. In fact, however, it is impossible to determine the polarity of one of these earth currents upon any two lines, no matter in what direction they are built.

In closing, let us urge upon telephone companies the necessity of doing all in their power to secure systematic observations of these electrical disturbances, and also of the minor currents so common upon their wires. It is in their power to add the most valuable information obtainable upon this very obscure matter; for they have wires running in every direction, and, unlike the telegraph companies, observations can be carried on while the wires are in use. It would be hard to predict what might not be the money value, to telephone companies, of a careful and systematic set of observations of this kind. It has been suggested, that lines should be constructed, in connection with our astronomical observatories, for this purpose; but no observatory could afford to construct such a system of observation wires as are possessed by our telephone exchanges; so that all that is necessary, is to connect the laboratory of the observatory with a central telephone office, by one or more wires, when observations could be taken, many times a day, upon wires of almost any length or direction, without inconveniencing the telephone companies in any way, and might lead the way solving the present difficulty of telephoning long distances.

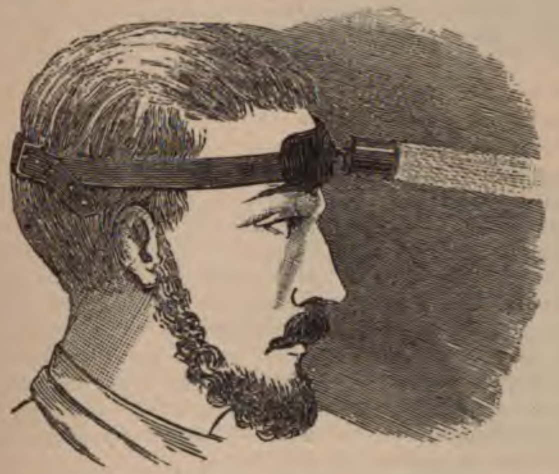
I remain, gentlemen, your obedient servant,
W. R. CABOT.

YONKERS, May 17th, 1883.

HÉLOT AND TROUVÉ'S FRONTAL ELECTRIC PHOTOPHORE.

THE frontal electric photophore, presented by Dr. Bouley to the Paris Academy of Sciences, and by Mr. Dujardin-Beaumetz to the Paris Academy of Medicine, in their sessions of April 16th and 17th, 1883, *L'Electricite* says, is a happy application to medical uses of incandescent electric lamps, *in vacuo*. Previously, it had been found impracticable to employ these apparatus, save on a large scale, and by working them with the aid of powerful dynamo or magneto-electric machines, or with accumulators charged by the same.

Mr. G. Trouvé, by making an important improvement in the bi-chromate battery, has made it possible to utilize this wonderful illuminating agency, for domestic purposes. Outstripping all competitors, he has made this light available for all, whereas, before, it appeared to be suited only for large manufactories, and other considerable establishments, that need not fear the expense of a costly plant.



Dr. Paul Hélot, surgeon-in-chief of the hospitals of Rouen, and Mr. Trouvé, have solved, in an equally satisfactory way, the problem of medical electric lighting. Their apparatus consists of a vacuum incandescent lamp, contained in a metallic cylinder, between a reflector and a focusing lens. This photophore, which is very light, and of but little volume, is applied to the forehead, after the fashion of the mirror employed by the laryngologist, or the aurist. The light furnished by it is very strong. A slight change in the position of the lens, alters the field of illumination with the greatest ease. Placed in the axis of the eyes, the light accompanies, so to speak, the eye of the operator, and he need have no concern about the management of it. In case it be deemed better to use the apparatus without having it attached to the forehead, it might readily be fixed to a support, resting on a table, on the arm of a chair, or any other piece of furniture.

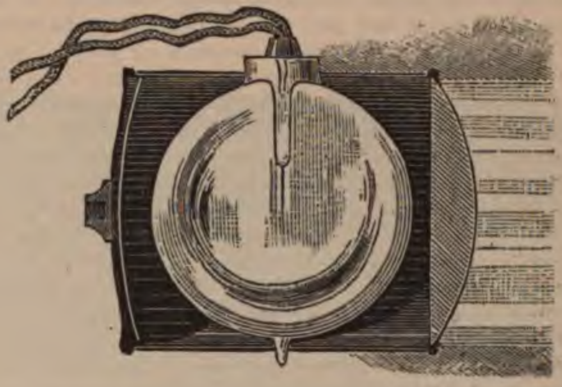
The source of electricity is the Trouvé's battery of supersaturated bi-chromate of potassia. This will serve for several hours, either continuously or at intervals, without needing to be renewed.

This powerful electric light apparatus may be employed in a multitude of cases, where there is need of illumining the field of a surgical operation, lying deep in the natural cavities of the body—as the mouth, throat, ears, etc.

Gynæcologists will often have occasion to employ it in certain delicate operations, where plenty of light is required. But it is especially in diseases of the larynx, and of the ear, that it seems likely to supersede all other apparatus; for the light it supplies is perfectly white, and in no wise changes the color of the tissues.

Henceforth, dentists will not be content to work their White's excavator by means of the battery and Trouvé's motor; they will be enabled, without materially adding to the cost, to illuminate, thoroughly, the cavity of the mouth, by means of the electric photophore.

The apparatus is both ingeniously contrived, and made in a workmanlike way, and with scientific precision. It is destined to find favor with physicians.



SECONDARY BATTERIES.

SECONDARY batteries, says the *English Mechanic*, or rather patents for them, are becoming as numerous as galvanic cells themselves, and the number of known combinations is very large, though an enumeration of those in practical use would not occupy much space. Probably, descriptions of secondary batteries already in use would not occupy many volumes, but certainly a mere list of the patents recently taken out for modifications of the Planté cell would occupy a column or two. There is, it must be confessed, a family likeness amongst nearly all of them, and it may be safely surmised that the patent office will reap the chief benefit, from a pecuniary point of view. One of the most recently patented, and most promising devices is that known as the B.T.K. cell, from the names of the patentees, J. S. Beeman, W. Taylor, and T. King, of Cannon Street, E.C. This invention relates to the formation of plates for electrodes, made of insulating tape-like materials in combination with suitable metal ribbons; also of insulating tapes covered with metal, in combination with an insulating ribbon, tape, or strip alone, or so used as to form a carrier or vehicle for salts of lead, or lead in a finely divided condition, such insulating carrier being sandwiched, so to speak, between the metallized ribbons, or their substitutes. The insulating carrier and metal ribbons may be made in any convenient manner, and may be corrugated longitudinally and transversely. The insulating strips are coated with the powdered and inert material on one side, and with salts of lead on the other. Part of the invention also refers to plates formed as above, and used in combination with an improved cell made of wood, soaked or coated with paraffine, lined with a cell of paper, treated with paraffine, and having a layer of paraffine interposed between the wood and paper cell. Sometimes an extra partial casing of sheet iron is used outside of the wooden one, with an interposed layer of paraffine wax. Part of the invention further relates, in combination with above improvements, or some of them, to a mode of connecting the different sets of plates together, so that any one plate may be easily removed; and the formation of a hook attachment for connecting the cells together, together with an improved valve for ventilating the cells; also, in combination with the improved plates, part of the invention relates to an improved mode of applying studs, rods, tubes, or equivalents (either alone or in combination with rings), to support and keep in position, together and apart, the plates—the studs, rods, tubes and rings being made of any convenient non-conducting material, such as glass, porcelain, vulcanite, or of metal or wood covered with non-conducting materials The invention refers, in combination with the improved cell, to the use of an insulated tray or stand supporting the cell, and for holding oil to prevent return current by earth. The claims in this case are for the construction substantially as described. Another device, which, however, proceeded no further than provisional protection, is that of Dr. Aron, of Berlin, in which the invention consists in impregnating capillary substances with a lead combination, and winding them on the polar plates. The capillary substances may be first stitched on lead plates, and subsequently impregnated with the active compound, and the polar plates may be of dialysing substances perforated, the outer wrappings being of wool, straw, or wickerwork Another patent is one to C. T. Kingzett, London, and relates to the form of the electrodes, as well as to the compounds used. The patentee prefers electrodes of a brush-like form, in which the "bristles" are hollow, and with the "back" are in one piece, which is inserted into the lead compounds. From practical investigations the patentee concludes, that while red lead may be usefully employed at the electrode, at which oxygen is set free during the charging process, it may be replaced with advantage at the other pole, by the sulphate, chloride, or oxychloride of lead; or, better still, a freshly prepared mixture of litharge and dilute sulphuric acid. Hydrochloric acid may be used as an electrolyte, and it is preferred to charge the cells in one direction only. The patentee refers to calcic hypochloride, as an agent for prolonging or revivifying the action of secondary batteries, and for securing free access of the electrolytic fluid to the various parts, uses pieces of tobacco pipes, wicks of porous material, &c. A patent obtained by J. E. T. Woods, London, strikes out a new line, for in this case the electrodes are made of carbon, or alloys of chromium and iron, or "other suitable metals," and are covered with a layer of an oxide of chromium, occasionally mixed with a little chromic acid, and retained in position by a covering of asbestos fabric, woven spun glass, or a diaphragm of porous earthenware. Chromic acid and protoxide of chromium are produced by the charging current. The patentee says, that permanganic acid as a permanganate and suboxide of manganese, or an oxide of copper, may be used with suitable electrodes, instead of the oxides of chromium. M. Somzée, of Brussels, has also obtained a patent, one part of which relates to a method of applying minium to lead plates by securing it with some agglutinative substance Another part describes a paste made of minium and powdered pumice, which admits of thorough penetration of the acid and current; and the pumice absorbing the acid, the battery is rendered dry. M Somzée also uses a light and porous coke, the interstices of which are filled with lead, by first soaking in a solution of the acetate, and reviving the metal by heat, and then pressing minium, or other suitable metallic preparation, into the pores. That object is effected in other ways—e g., by mixing the pulverized minium and coke with sugar or other agglutinative matter, and heating the slabs so formed in such a manner, that while the metal is obtained in the desired state, the block is kept as porous as possible. Such are a few of the recent ideas in connection with the formation of secondary batteries; but it may be doubted whether any of them are better than the simple Planté form, when that has been brought into its best working condition.

Mr [illegible], and others, filed papers on May 7th, with the [illegible] of this State, incorporating the Electric Railway Company of [illegible] United States, capital, $[illegible]. The Molecular Mutual Tele-[illegible] and Telegraph Company was also incorporated, same date.

M. [illegible] has lately measured the electric resistance of [illegible] a condenser from a known battery through a given [illegible] and observing the time required to raise the poten-[illegible] to a given degree Bohemian glass was found to be [illegible] good a conductor as ordinary glass, whilst flint glass [illegible] times as good an isolator. M. Foussereau [illegible] increased its resistance, in some cases [illegible]

TYPES OF LUMINOUS ELECTRICAL PHENOMENA.

BY DR. W. HOLTZ.

In Zeitschrift für Angewandte Elektricitätslehre.

(Translated for THE ELECTRICIAN.)

I HAVE treated, in previous articles, of the various phenomena of light, which an induction electrical machine will give without any important subsidiary apparatus; but, I have always felt that it was exceedingly difficult to convey an idea of these phenomena by mere words I have, therefore, made an attempt lately to permanently fix their most characteristic forms, by means of pictorial representations, and beg, herein, to offer a series of those which may be classed as the so-called *one sided brushes*. The term brush, is applied to a phenomenon, that consists of numerous rays of light, that is only perceptible in the dark, whose advent is announced by a slight noise only, and which is developed between oppositely electrified bodies, especially in air media—as the effect of a quiet and continuous electric transmission. In order to create them with more certainty, the so-called condensers must be removed from the machine, and the electrodes placed at a considerable distance from each other. Brushes are termed partial, when they keep to one electrode only, or when although appearing on both, yet run in a conical shape in one direction only. They are called *positive* or *negative*, respectively, according to the kind of electricity of the electrode to which they are attached, or toward which the stem of the luminous globe is directed.

To obtain them with the greater certainty in the one sided form, we must deflect the other electrode in question, but the consequence of this is that the appearance loses in extent.

These partial brushes are very differently constituted in two respects: First, in their outer form, and then in their internal structure. Next to the nature of the interpolated medium, the kind of electricity has most influence, and then, the shape, size, and distance of the electrodes. We shall not take the first factor into consideration here, as the accompanying illustrations refer to appearances, that are obtained in ordinary *air only*. That the source of the electricity producing them has an influence, I have already given to understand; but as this factor may also be considered as of secondary importance, it shall only be treated of incidentally.

The following are the shapes and sizes of the electrodes that I used: At one time I employed the ordinary pointed ends of the discharging rods; then three different kinds of globes, viz., of twenty-five fifty-five, and ninety millimetres; finally a hollow disc, with a semi-circular edge, that measures thirty-five millimetres in thickness, and 230 millimetres in diameter. I need not go into any further description, as each piece will be easily recognized, in the illustrations, and as everything else is drawn according to proportion.

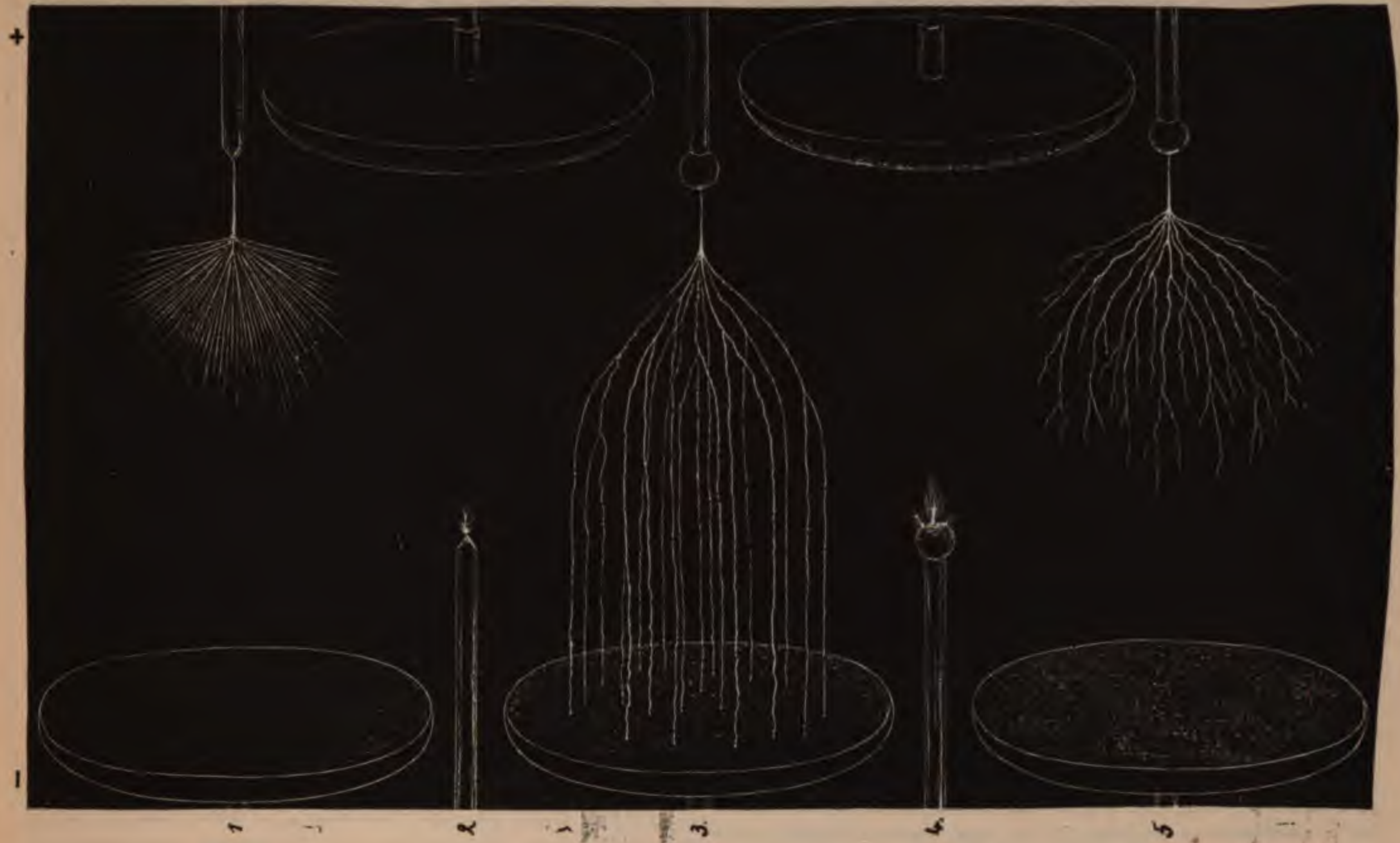
I may mention, however, that a medium sized machine with a rotatory disc of 400 millimetres, was employed.

The positive brushes, as will be seen at once from the cuts, are always to the right, while the negative appear on the left. I have thus sketched them to make the subject clearer. It is simpler, in experimenting, to have electrodes unchanged as little as possible, and to this end to let the machine work more frequently oppositely.

Fig. 1 shows first, the positive brush with long stem and short, straight collateral lines, which are very fine and have a great divergence. With a sharp point, or feeble action, we have a weak, glimmering light instead, while a sharp point with strong action may also produce slender brushes. Very characteristic of the point, is the straightness of the converging lines, as they may also be met with in very small globes, but never with large ones.

Fig 2 represents the small negative brush, which, under conditions, in other respects the same, forms a small ball that is likewise formed of equally straight but fine lines that fix themselves just at the top. It might be taken, on account of its smallness, for a mere glimmer, if its shape were not remarkably like that of the larger negative brush.

In Fig. 3 we perceive the large positive brush with long stem, and long, but slightly diverging, branches, which bifurcate, and are split up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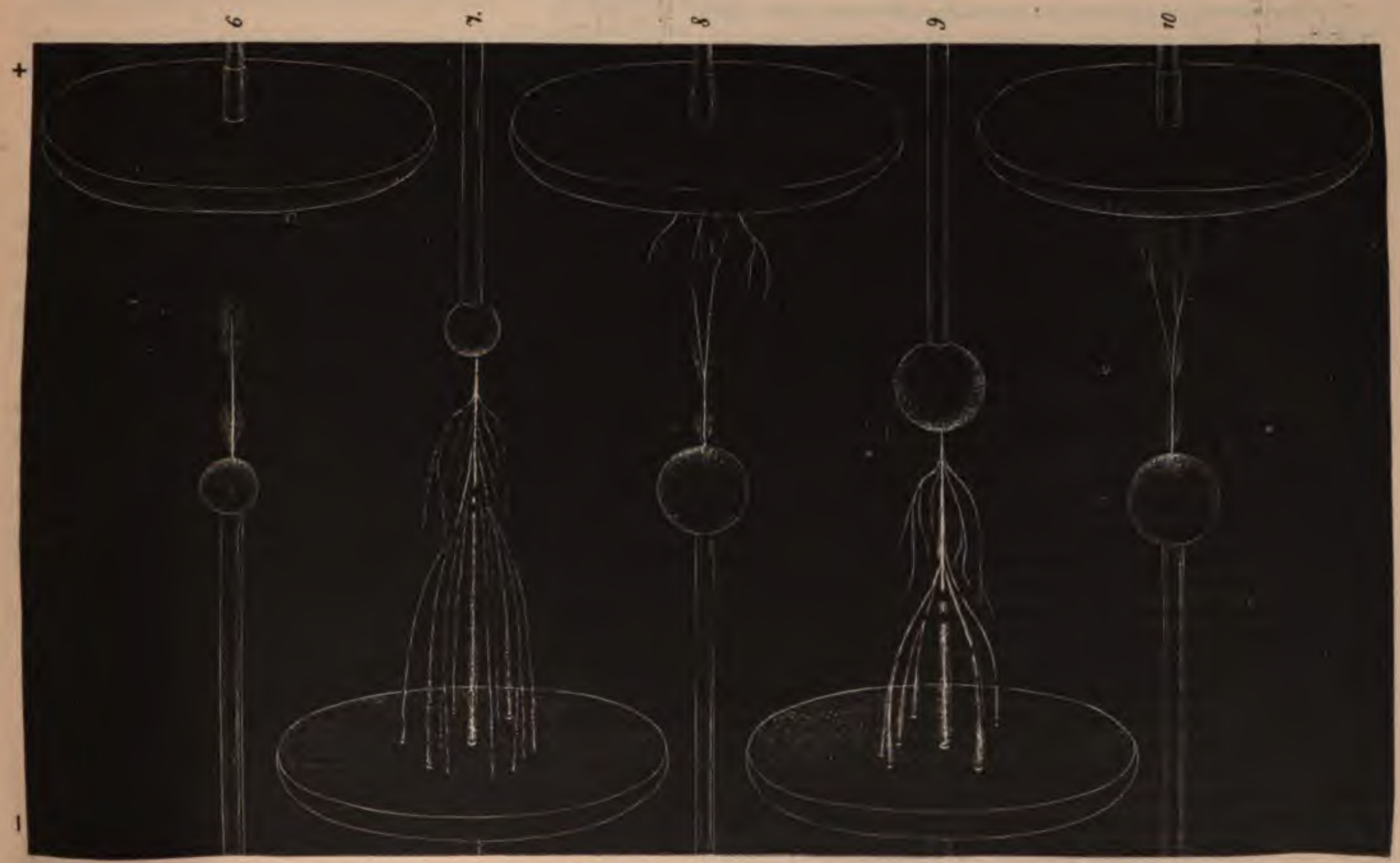
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into other branches. This tree-like, crooked, and repeated ramification, is characteristic of the action of the ball when it is held opposite the point. The further course of the branches, and the mitre-shaped appearance of the whole, is still more the effect of the hollow disc, and the circumstance that this is not derivated.

In Fig. 5 we meet with the same conditions, with the exception that the disc is derivated. If a smaller surface were in the place of the disc, this would act similar to a derivative, at least in this especial case, while otherwise, derivation and enlargment of the surface are equivalent. We see that a shorter brush, which is in shape like a tree, will be completely extinguished from time to time, while a glimmering light covers the front conic surface The intermittency with the glimmering light is less frequent with derivation, than when a smaller surface is used.

If we examine the small negative brush, under similar circumstances, in Fig. 4, we shall find that it is quite like that in Fig. 2, only that it is somewhat longer shaped. We do not meet it, however, any longer isolated, but in company with smaller ones, which is as well a distinctive difference between the ball and the point action, as between the negative and the positive brush.

It has also this peculiarity, that it adheres less persistently to a fixed point, and apparently flees from the medium line.

If we allow the brushes to grow, as in Fig. 9, the same negative brush will grow longer; but its lengthening does not occur in a simple manner—a longer brush rather grows out of a shorter one. A conical shaped, luminous brush is seen on the longer stem, while the foot of the latter is enveloped by a second and similar luminous brush. The primary effect of increasing the size of the globe, is to extend the phenomenon to a greater length, while it also receives a stem, which was not previously visible.

The increase in the globe has an almost contrary effect on the positive brush. The discs must be brought closer together, to obtain analogous appearance to those in Fig. 3. The brush, in fact, grows shorter; but a ramification in the midst of the stem, which is otherwise quite branchless, appears simultaneously as seen in Fig. 7. The shortening is otherwise balanced by a thickening—especially of the lines—which fully reach the disc. Dark spaces, which, however, are only relatively so, may be perceived in these brushes, but at a greater distance from the disc. The derivation acts rather less in these circumstances in lifting the brush from the disc; no luminous appearance is formed.

The positive brush grows continually shorter, when larger globes are employed, while at the same time, the branches tangent to the disc become thicker. At the same time the dark intervening spaces increase in number, or in size, and approach nearer to the disc, as represented in Fig. 6. The number of light lines decrease, however. Finally, the brush is mixed with bright sparks, and this is especially favored by derivation.

The negative brush, on the other hand, becomes longer, when larger globes are used. It becomes, in two respects, more like the positive, in that its stem becomes more clearly defined, and its tendency to ramification increases. But, in respect to the latter, there still remains a material difference. In the first place the ramification appears isolated; seldom is there any secondary formation; then each branch is surrounded like the head stem, at its foot, by a conical shaped sheaf of light. In such they also terminate, just as if they were isolated, self-exisiting brushes. Finally, they show only a very slight divergence. There is yet another circumstance that is characteristic of the negative brush. Its twigs cannot be made to fully reach the disc. Still, on a nearer approach, as in Fig. 8, a peculiarly formed positive brush emerges, spark-like from the disc. The entire appeaance is then, properly speaking, no longer a partial brush, but is so to the extent, that a partial brush is periodically seen. In other respects, the general rule for the formation of two sided brushes, also holds good here, viz., that brush ends never come into full contact with one another.

To obtain the long stemmed negative brush, as much as possible, by itself, a certain distance of the electrodes must be kept, which is, of course, dependent on the size of the globe and the efficiency of the machine. Very dry air is requisite, however, to have it of full length, and the room must be very dark to see it clearly. Then it will be observed, as in Fig. 10, that its separate branches are interspersed with a great number of small, dark spaces, which correspond to those of the positive brush, only that they are much smaller and more numerous.

A material prolongation of the negative brush may be also produced by using smaller globes, and covering them with thick layers of silk material.

A few well-known facts, with regard to light and color, may be mentioned, for a better comprehension of the drawings. The stem of all brushes is brighter than its ramification, and this becomes weaker in light, in proportion as it extends. Those branches, which, however, fully reach the second electrode, stop there with a relatively bright light disc. The stem is, on the average, more violet, the branches of a bluer shade; otherwise, the violet is more peculiar to the negative, and the blue to the positive brush. Those branches that do not terminate in air, but lead up to the electrode, have always a dash of violet; the violet color increases with the size of the globe, or generally with the size of the discharging surface.

So far as acoustic qualities are concerned, we find that more of a hissing hoise accompanies the negative brush, while the positive has more of a humming sound—that is, the tone of the negative is generally higher. But the tone from both brushes becomes deeper as larger globes are used, and so, it finally happens, that the tone of the negative would become a humming one if the globe used were sufficiently large. It has long been known that these distinctive noises have their origin in the slower, or more rapid sequence of incomplete discharges.

ELEMENTS OF ANALYTICAL ELECTROMETRY.

NEW YORK, April 15th, 1883.

To the Editor of the Electrician.

DEAR SIR:—In the following, I have the pleasure to submit to you an essay on the "Elements of Analytical Electrometry." It is my purpose to give a general formula, which will enable one to find the electrical resistance of any conducting surface, if its shape is given by an analytical formula.

Most truly,

F. HOFFBAUER.

If in any conducting surface an electric current passes from the point A to the point B, then the lines of equal potential are circles over a diameter, the ends of which intersect the line $A\,B$ in an harmonical proportion; and the lines of forces or circles passing through A and B, with the centre on that line, which intersects the line $A\,B$ in its centre at right angle.

Supposing the surface would be bounded by two circular arcs passing through A and B, one above the line $A\,B$, the other below, both from the radius (r); and, further, supposing $A\,B=(2a)$, the thickness of the surface (m), and the X axis falling in the direction of $A\,B$, and the Y axis in its centre at right angle, then the resistance of each material equal potential line is $\frac{d\,x}{m, f, (x, y, r.)}$ and the resistance of the full surface is

$$p \cdot \frac{1}{m} \int_{x=-a}^{x=+a} \frac{d\,x}{f\,(x, y, r)}$$

p is the relative resistance of the material.

To apply above formula to a surface [given by the formula (I) $y = f\,(x, a)$], we have to find those circular arcs above and below $A B$, and passing through A and B, which are touching the boundings of the surface given, and then we proceed as stated above.

If one curve is touching the other, they have for this touching point the same tangent, and, therefore, we have to find the co-ordinates of the touching point. The formula of the tangent is (II) $x = y \, cotg \, d + q$, where d is the angle between the tangent and the x axis, and q the piece, which the tangent and the y axis cuts out the x axis. The formula for the circular arcs $\surd$(III) $x^2 + y^2 + {}^2y z = a^2$, where z is the distance between the circular centre and the line $A B$.

$$\text{Out formula (I) } cotdg = \frac{d f (x a)}{d y}$$

$$\text{Out formula (III) } cotdg = -\frac{y + z}{x}$$

Those results combined with formula (II) give

$$(1) \; x = y \frac{d f (x \; a)}{d y} + q, \text{ and}$$

$$(2) \; x = -\frac{y + z}{x} y + q$$

now in (1) is $x = f (y \; a)$, in (2) $x = \sqrt{a^2 - y^2 - {}^2y z}$ this is sufficient to find the value of y.

Suppose, for example, the given surface is an ellipsis $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, then we have $cotyx = -\frac{y a^2}{x b^2}$ and $x = a \sqrt{1 - \frac{y^2}{b^2}}$, and therefore $q = \frac{a^2}{x}$; further, we have $-\frac{y + z}{x} = \frac{x}{y - c}$, therefore, as

$$c = \frac{b^2}{y} \text{ we have}$$

$$z = y \frac{(x^2 + y^2 - b^2)}{b^2 - y^2}, \text{ and further,}$$

$$q = \frac{a^2 - y z}{x}, \text{ therefore,}$$

$$\frac{a^2}{x} = \frac{a^2 - y z}{x}$$

$$y z = o$$

$$x^2 + y^2 - b^2 = o$$

$$y^2 + a^2 (1 - \frac{y^2}{b^2}) = b^2$$

$$y^2 \frac{a^2 - b^2}{b^2} = b^2 - a^2$$

$$y = b$$

This result means the circular arc touches the ellipsis on the end of its short axis (b); the diameter of the arc is

$$2 r = \frac{a^2 + b^2}{b}$$

SPARKS.

—— THE QUEEN has knighted Dr. C. W. Siemens, F. R. S.

—— AMONGST THE EXHIBITS at the Vienna electric exhibition, will be Prof. Fleeming Jenkin's telpherage system; Ayrton and Perry's electric railway; many well-known firms with dynamos, lamps, and other appliances; and the Duplex Electric Light and Power Storage Company, with a new battery, said to yield valuable residual products. Herr Bornhardt, of Brunswick, amongst other exhibits, will show influence-machines, with 20, 30, and even 60 discs.

—— THE NEW ORLEANS *Times Democrat* gives the following: "At the Brush electric light station, at the corner of Notre Dame and Front Streets, there is a dog-trap, which is somewhat remarkable, and the effect produced on prowling canines very peculiar. A space on the floor is dampened, and one wire from an electric light, connected with the spot, in the centre of which is a piece of meat, with the other wire attached to it. A dog entering the establishment, is naturally attracted by the meat, and approaches it, having to stand on the moist space. The moment he touches the meat, the circuit is made, and the intruder is thrown some distance by the shock. The other night, an Irish bull-dog made four attacks on the meat, and had, after a severe shaking, to relinquish his grip on the toothsome bait. The stroke passing over the small wires used is not sufficient to kill, yet it is severe enough to impress the dogs with its force, and they rarely return."

—— THE PATENT OFFICE *News*, May 15, says. "The Examiner of Interferences will soon render a decision in the celebrated telephone case in which Messrs. Bell, Gray, Edison, McDonough, Dolbar, Boelker, Blake, Irwin, and Richmond, are interested. This decision will involve the settlement of eleven different cases, represented by the parties above named. Originally, there were other parties in interest, but they have dropped out, or their interests absorbed by those now actively contesting. The cases have been pending since 1878, and the arguments were made before the examiner in October, 1881, more than eighteen months ago, The testimony is embraced in five large books, and the decision of the examiner will be an elaborate and exhaustive treatment of the subject involved. The examiner has gone into the matter carefully, and his decision will cover over 700 pages of manuscript. The principal point involved, is the arc of the transmitter, which Bell claims, and upon which he has been receiving, large royalty from all other companies.

—— *La Nature* says: By the following simple method, plates for telephones and microphones may be made of any thickness. One or more plates of the desired shape and size are cut out of a piece of sheet iron. After dressing, rub them well on both sides with a dry cloth; this is essential to obtain an equal thickness, as otherwise the greasy spots left by handling, would prevent a uniform action of the acid. It is better, also, to treat only one plate at a time. After wiping the plate well, it is plunged vertically, so as to be submerged in a bath of azotic acid. Acid that has been used several times in a Bunsen battery can be used, or else the azotic acid of commerce, with the addition of one-fourth of water. The plate must be taken out frequently to ascertain the thickness. When the proper thickness is obtained, the plate is well washed in water, until the coating of blackish rust or oxide has completely disappeared; it is then let dry and one or more coatings of black Japanese varnish given on both sides to prevent oxidation. In this way, plates may be obtained as thin as desired, and of all shapes and sizes. When membranes are used in microphones, this is no slight advantage.

BUSINESS NOTICES.

NOTICE.

THE pressure upon our columns this month, compels us to defer publication of some interesting matter until our next issue.

ONE of the Commissioners of the Franklin Institute to the Vienna International Electrical Exhibition, will take charge of American exhibits, and correspond for a few American papers while in Vienna

Address CARL O. HERING,
University of Penna., Philadelphia, Pa

WANTED—Clean copies of THE ELECTRICIAN, for March and August, 1882, for which fifty cents each will be paid. Address, W. K. FREEMAN, 38 East 14th St., New York.

WANTED, by a young man of large experience (now running 58 lights), a situation with an Electric Light Company, can furnish ample reference as to ability, &c. Address, A. J. C. care of ELECTRICIAN, Room 55, 115 Nassau Street, New York.

THE WEST INDIA TELEGRAPH AND TELEPHONE CO., Limited. Capital stock, $150,000; shares, $10 each, full paid, and non-assessable. Transfer office, Long Branch, New Jersey. This company has acquired, and *owns*, all the telephonic rights, formerly the property of the Continental Telephone Co., and Tropical American Telephone Co., for the *exclusive* rights to operate on the islands of Hayti, San Domingo, Jamaica, Porto Rico, Vique Culebra, St. Croix, and St. Thomas. This company *buy* their telephones and transmitters. A portion of the stock is *offered* for sale.

Address the company, Chillicothe, Ohio.

IT was our pleasure, a few days since, to witness the practical use of the Elgin Telephone. The line we talked over was between two residences, the voice came from the distant end, clear and loud, so as to be distinctly audible several feet away from the instrument. For the purpose intended, we think it fills the bill to perfection. We understand the Elgin Telephone is fast becoming the standard instrument; for short private lines, as we find them in the regular catalogues of our prominent electrical dealers in all the large cities. Mr. Wm. Hubbard, the inventor and patentee, is an old telegrapher, and has been local manager of the large telephone exchange in Kane County, Ill., for several years, and naturally knows what is required in a telephone.

THE ADAMS & WESTLAKE WIRE GAUZE NON-EXPLOSIVE OIL STOVE. This stove is, beyond all question, the safest, most durable, and simplest in construction, the easiest to regulate and keep clean, and produces the most heat, in proportion to wick surface, of any stove in the market. It is the only oil stove made on which other cooking can be done while baking or roasting. This oil tank and all parts are of cast iron, save the drum and wick tubes, making it strong and substantial. The wick tubes are adjustable, making it convenient for repairing, or to remove a wick should one get into the reservoir.

It will bake biscuit in twelve minutes, and boil a gallon of water in fifteen, thereby surpassing all former claims made for oil stoves.

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CHARLES WILLIAMS, JR.,
109 to 113 Court Street, Boston, Mass.

BRADLEY A. FISKE,
Consulting Electrical Engineer,
59 Astor House, N. Y.
Opinions, Calculations, Estimates, etc.

BOOK NOTICES.

ALLISON'S DICTIONARY OF ELECTRICITY; cloth, 12mo., 192 pp., 96 illustrations; price $2. ALLISON'S COUNTING HOUSE DICTIONARY AND DICTIONARY OF ELECTRICITY; 576 pp., 300 illustrations; $3. STORAGE BATTERIES; 60 pp., illustrated, paper cover; 50c. The above works sent prepaid, on receipt of price. See ELECTRICIAN, April No., page 117. Address, WM. L. ALLISON, 191 Fulton Street. New York.

RECENT WONDERS IN ELECTRICITY, Telegraphy, Magnetism, Electric Lighting and Telephony. Contains descriptions by Count du Moncel, Dr. Siemens, etc. Nearly all recent inventions illustrated or described. 100 pages. $2.00.

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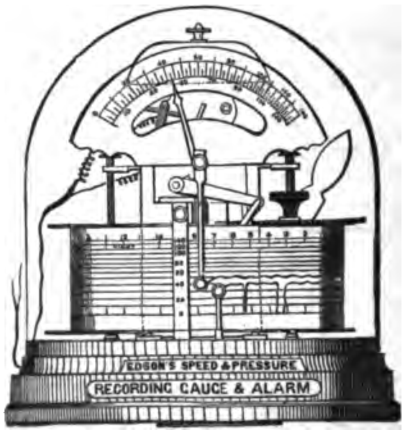
Edson's Combined Speed and Pressure Recording Gauge and Alarm.

For Offices of Factories, City Water Works, Steamers, Hospitals, Hotels, etc.

The day has passed for basing steam boiler or engine performance upon assumed bases or conditions. Pressure of steam taken from gauges by ocular observation or piston speed by counting the revolutions by watches are not close enough to give a true mean. An actual average can only be obtained by the actual record of work done for every moment of work. With this as data, the engineer can obtain more than approximate results; he will have mechanical facts as easily read by an expert as a printed page.



Edison's recording steam gauge and speed record is a new device attached to the gauge whose merits are so well established, and it achieves positive results in regard to records which is so essential to estimating the commercial value of the work of the steam-engine.

The speed recording apparatus is driven by a belt from any principal part, and shows the fluctuations from a regular velocity on the same chart as the records from the steam gauge.

Besides these features of excellence there is an alarm gong operated by a special mechanism, whereby notice is given when the limit of "high" or "low" pressure is reached, and a corresponding alarm can be sounded any distance from the gauge by the addition of an electric alarm apparatus.

Among the many mills now using the Edson Recording Gauge and Alarm are: the Social Cotton Mills, Woonsocket, R. I.; Harmony Mills, Cohoes, N. Y.; Merrimack Mills and Print Works, Lowell, Mass; Pacific Cotton Mills, Lawrence, Mass.; Oriental Print Works, Apponaug, R. I.; Mt. Vernon Mills, Baltimore, Md.; Dolan, Cotton Mills, Philadelphia, Pa.; Passaic Print Works, Passaic, N. J.; Rittenhouse Mfg. Co., Passaic, N. J.; J. N. Stearns Silk Mfr., New York City; Nottingham Lace Works, Brooklyn, N. Y.

Further information may be obtained by addressing the Edson Recording and Alarm Gauge Company, 77 Liberty street, New York.

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MANUFACTURERS OF

SHEET BRASS, BRASS WIRE, RODS AND TUBING, COPPER RIVETS AND BURS,

Pure Lake Superior Copper Wire

FOR ELECTRICAL PURPOSES.

INSULATED ELECTRIC LIGHT

: AND :

Patent "K K" Insulated Copper and Iron Wire.

The Iron is Specially adapted for Telephone Use.

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Works at Waterbury, Conn.

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Electric Storage Company.

We desire to arrange with Electric Lighting Companies, for the introduction of our batteries, and also with parties competent to organize sub-companies.

A Manufacturing Company, that will have control of our patents, to supply our Licencees with batteries, is being formed. Parties desirous of interesting themselves in this valuable invention, can see it in operation at **237 Broadway, Room 40, New York City**, under charge of **Prof. N. S. Keith.**

All correspondence received will have attention at an early day.

The American Electric Storage Company,
792 Broad St., Newark, N. J.

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THE

United States Illuminating Co.

59 Liberty St., New York.

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THE UNITED STATES ELECTRIC LIGHTING CO.,

for the City of New York and vicinity.

The Machines and Lamps manufactured for this Company are under patents of **Maxim, Weston, Farmer and others,** and comprise all the latest improvements in Electric Lighting.

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President.

EQUITABLE
LIFE ASSURANCE SOCIETY.

OF THE UNITED STATES.

No. 120 BROADWAY, New York.

JANUARY 1, 1883.

(On 4½ per cent. Basis.)		(On 4 per cent. Basis.)	
Assets, -	**$48,025,751**	**Assets, -**	**$48,025,751**
Liabilities,	**37,367,076**	**Liabilities,**	**39,949,454**
Surplus, -	**$10,658,675**	**Surplus, -**	**$8,076,296**

RATIO of Surplus to Liabilities of the leading life insurance companies on a four per cent. basis:

	ASSETS.	LIABILITIES.	SURPLUS.	RATIO.
EQUITABLE............	$48,025,751	$39,949,454	$8,076,296	20.21
NEW YORK............	50,800,396	43,760,183	7,040,213	16.09
MUTUAL, N. Y.........	97,961,317	93,349,903	4,611,414	4.94

The amount of New Business transacted in 1882 by the Equitable Life Assurance Society exceeded the largest business ever done by any company in one year.

INDISPUTABLE INSURANCE

AND

PROMPT PAYMENT OF CLAIMS.

The Equitable having declared its policies, over three years in force to be **Indisputable,** will pay all such indisputable policies at maturity, without rebate of interest, immediately after the receipt at the Society's office in New York, of satisfactory proofs of death, together with a valid and satisfactory discharge from the parties in interest.

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JAMES W. ALEXANDER, 1st Vice-Pres.
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WILLIAM ALEXANDER, Secretary.

Life Insurance Agents desiring to connect themselves with THE EQUITABLE LIFE ASSURANCE SOCIETY in which they will enjoy the greatest facilities for transacting business, may communicate with the officers at 120 Broadway, New York.

PATENTS FOR APRIL AND MAY, 1883.

APRIL 24th.

276,216	Electric Circuit Switch Board. F. Blake, Weston, Mass.
276,228	Electric Cut-out. E. M. Avery, Cleveland, O.
276,286	Electric Cut-out. T. H. Rhodes, Brooklyn, N. Y.
276,275	Electric Generator, Dynamo. C. C. Peck, and W. H. Chapman, Middlebury, Vt.
276,194	Electric Machine, Dynamo. H. Roberts, Pittsburg, Pa.
276,190	Electric Wire Conduit. J. A. Mehaffey, Parnassus, Pa.
276,486	Electric Wires, Laying Underground. C. D. Shrieves, and J. E. Cook, Philadelphia, Pa.
276,233	Electrical Generator and Motor. T. A. Edison, Menlo Park, N. J.
276,232	Electrical Generators, Operating and Regulating. T. A. Edison, Menlo Park, N. J.
276,263	Electrical Switch Board. C. W. McLean, Newberne.
276,285	Gas by Electricity, Push-bottom and Circuit for Lighting. T. H. Rhodes, New York, N. Y.
276,290	Magneto and Dynamo electric Machines. A. I. Gravier, Paris, France.
276,274	Magneto-electric Generator. C. C. Peck and W. H. Chapman, Middlebury, Vt.
276,155	Secondary Battery. C. F. Brush, Cleveland, Ohio.
276,348	Secondary Battery Element. C. F. Brush, Cleveland, Ohio.
276,300	Secondary or Storage Battery. E. T. and E. E. Starr, Philadelphia, Pa.
276,301	Secondary or Storage Battery. E. T. and E. E. Starr, Philadelphia, Pa.
276,472	Telegraph Line, Underground. N. M. Rittenhouse, and M. W. Locke, Baltimore, Md.
276,184	Telephone and Telegraph Switches, Electric Time Register for. F. E. Kinsman, New York, N. Y.
276,465	Telephone Call Indicator. J. M. Provoost, Buffalo, N. Y.

MAY 1st.

276,739	Annunciator, Telephonic. G. L. Weaver, Boston, Mass.
276,960	Electric Call. J. B Currier, and D. H. Rice, Lowell, Mass.
276,568	Electric Machines, Armature for Dynamo. L. Daft, Greenville, N. J.
276,953	Electric Way. E. M. Bentley, Washington, D. C.
276,954	Electric Way. E. M. Bentley, Washington, D. C.
276,757	Electric Way. E. M. Bentley, and W. H. Knight, Washington, D. C.
276,829	Electric Way. W. H. Knight, and E. M. Bentley, Washington, D. C.
276,880	Electrical Conductor. T. S. Reed, Bridgeport, Conn.
276,725	Electrical Purposes, Covering Wire for. J. J. C. Smith, College Point, N. Y.
276,724	Electrical Purposes, Machine for Covering Wire for. J. J. C. Smith, College Point, N. Y.
276,840	Heating Apparatus, Electrical. A. Lieberman, and W. Robb, Philadelphia, Pa.
276,891	Insulating Electrical Conductors. J. G. Sanderson, Scranton, Pa.
276,916	Insulating Conductors and a New Compound, suitable to be used for this and other purposes. W. Smith, Wharf Road, City Road, County of Middlesex, England.
276,839	Insulator for Telegraph Wires. J. S. Lewis, Birkenhead, County of Chester, England.
276,565	Lamp, Electric-arc. L. Daft, Greenville, N. J.
276,566	Lamp, Electric-arc. L. Daft, Greenville, N. J.
276,567	Lamp, Electric-arc. L. Daft, Greenville, N. J.
276,571	Lamp, Incandescent Electric. P. Diehl, Elizabeth, N. J.
276.703	Lamp, Voltaic-arc. O. A. Moses, New York, N. Y.
276,704	Lamp, Voltaic-arc. O. A. Moses, New York, N. Y.
276,705	Lamp, Voltaic-arc. O. A. Moses, New York, N. Y.
276,924	Lamps, Glass Bulb or Globe for Incandescent Electric. A. Swan, Gateshead, County of Durham, England.
276,569	Railway, Electric. L. Daft, Greenville, N. J.
276,807	Railway Signal, Electric. A. W. Hall, Meriden, Conn.
276,974	Secondary Battery Plate. C. H. Koyl, Baltimore, Md.
276,604	Telephone Call, Individual. J. A. Lakin, Westfield, Mass.
276,630	Telephone, Electric. J. H. Robertson, New York, N. Y.
276,631	Telephone, Electric. J. H. Robertson, New York, N. Y.
276,723	Telephone Receiver. G. E. Shaw, Chicago, Ill.
276,632	Telephone Transmitter, Electric. J. H. Robertson, Brooklyn, N. Y.
276,702	Voltaic-arc Light. O. A. Moses, New York, N. Y.

MAY 8th.

277,286	Annunciator and Communicating Apparatus, Electric. W. Humans, Cambridgeport, Mass.
277,296	Burglar Alarm, Ringing. A. W. Lawson, Midway, Ala.
277,104	Clock Winding Device, Electric. G. F. Ballou, Waltham, Mass.
277,036	Electric Conductor or Cable, Underground. J. B. Hyde, New York, N. Y.
277,089	Electric Conductors, Manufacture of Silicious Copper and Bronze for making. L. Weiller, Angouleme, Charente, France
277,087	Electric Divining Rod. C. F. Varley, Bexley Heath, County of Kent, England.
277,237	Electric Machine, Dynamo. J. A. I. Craig, Montreal, Quebec, Canada.
277,238	Electric Machine, Dynamo. J. A. I. Craig, Montreal, Quebec, Canada.
277,119	Electric Machines, Armature for Dynamo. L. Daft, Greenville, N. J.
277,374	Electrical Conductor. S. D. Strohm, Philadelphia, Pa.
277,020	Fire Alarm Box, Electric. B. Frese, Chicago, Ill.
277,053	Gas by Electricity, Device for Lighting. J. B. Odell, Chicago, Ill.
277,248	Insulated Conductor of Electricity, Electro plated. N. H. Edgerton, Philadelphia, Pa.
277,366	Insulated Electrical Conductor. W. Smith, Wharf Road, City Road, County of Middlesex, England.
277,166	Lamp. Electric-arc. A. Shedlock, Brooklyn, N. Y.
277,167	Lamp, Electric-arc. A. Shedlock, Brooklyn, N. Y.
277,168	Lamp Holder, Electric. A. Shedlock, Brooklyn, N. Y.
277,377	Lamp Hood, Electric. S. H. Tacy, New York, N. Y.
277,069	Magneto-electric Machine. C. A. Seeley, New York, N. Y.
277,390	Railway Signals, Circuit Instrument for Electric. J. Weis, Jersey City, N. J.
277,358	Railway Trains, Electric Signaling Apparatus for. F. A. Shaw and H. E. Judkins, Portland, Me.
277,179	Speed Indicator, Magnetic. E. Weston, Newark, N. J.
277,349	Telegraph, Automatic. J. H. Rogers, Washington, D. C.
277,335	Telegraph Cable, Splice. W. R. Patterson, Chicago, Ill.
277,007	Telegraph Line, Underground. W. Cohlman, Philadelphia, Pa.
277,112	Telephone. H. Clay, Philadelphia, Pa.
277,199	Telephone, Receiving. M. L. Baxter, Aurora, Ill.
277,198	Telephone, Receiving. M. L. Baxter, Aurora, Ill.
277,145	Telephonic and other Electrical Purposes, Line Changer for. C. H. Lothrop, Lyons, Iowa.
277,241	Thermostat. W. G. Day, Baltimore, Md.

MAY 15th.

277,738	Burglar Alarm, Ringing. T. E. James, Rochester, N. Y.
277,640	Circuit Controller Device. E. Weston, Newark, N. J.
277,523	Electric Cable Support. A. Wright, Providence, R. I.
277,628	Electric Lock. M. Sullivan, Brooklyn, N. Y.
277,644	Electric Machine, Dynamo. E. Weston, Newark, N. J.
277,588	Electric Wires, Laying Underground. J. Marks, Newark, N. J.
277,475	Electro-magnetic Engine. G. W. Foster, New York, N. Y.
277,610	Gas Lighting, Electric. T. H. Rhodes, Brooklyn, N. Y.
277,536	Head Light for Locomotives, etc., Electric. F. Ball, Jr., Cincinnati, Ohio.
277,519	Insulating Wire for Electric Purposes. J. J. C. Smith, College Point, N. Y.
277,646	Lamp and Holder, Electric. E. Weston, Newark, N. J.
277,645	Lamp and Holder therefor, Electric. E. Weston, Newark, N. J.
277,641	Lamp Bracket, Electric Incandescent. E. Weston, Newark, N. J.
277,642	Lamp Bracket, Electric Incandescent. E. Weston, Newark, N. J.
277,846	Lamp Carbons, Manufacturing Incandescent. H. S. Maxim, Paris, France.
277,643	Lamp Fixture, Electric. E. Weston, Newark, N. J.
277,731	Measuring and Recording Electric Currents, Apparatus for. J. Hopkinson, Westminister Chambers, County of Middlesex, England.
277,569	Railway Signal, Telegraphic. R. M. Hunter, Philadelphia, Pa.
277,445	Secondary Battery. E. Boettcher, Leipsic, Germany.

BUSINESS ADDRESSES.

Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Bradford, C., Solicitor of American and Foreign Patents, 16 & 18 Hubbard Block, corner Washington and Meridian Streets, Indianapolis, Ind.

Burnap, W. H., Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q., Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Fairman, James F., Telephone, Telegraph, and Electric Light Supplies, and apparatus, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C., Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 43 Centre Street, New York.

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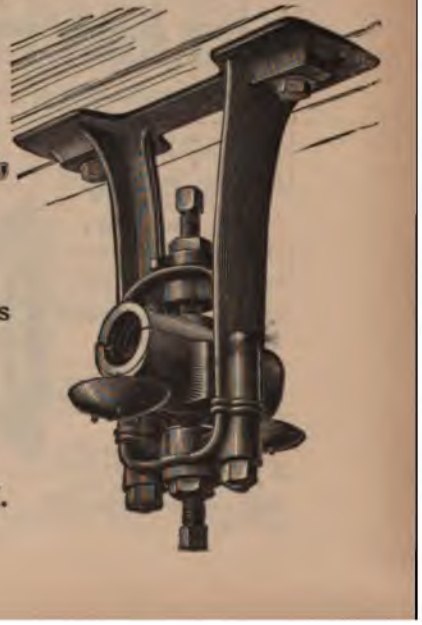

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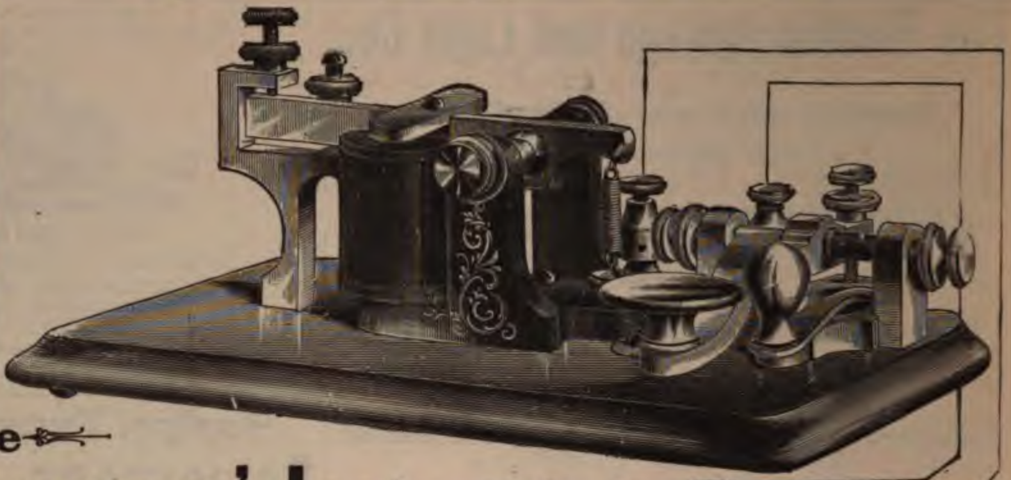

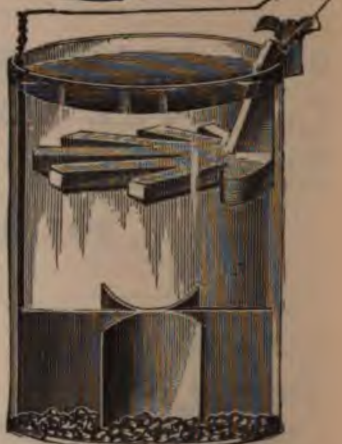

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18	.049 "	" 40 "	" 165 "	90 "

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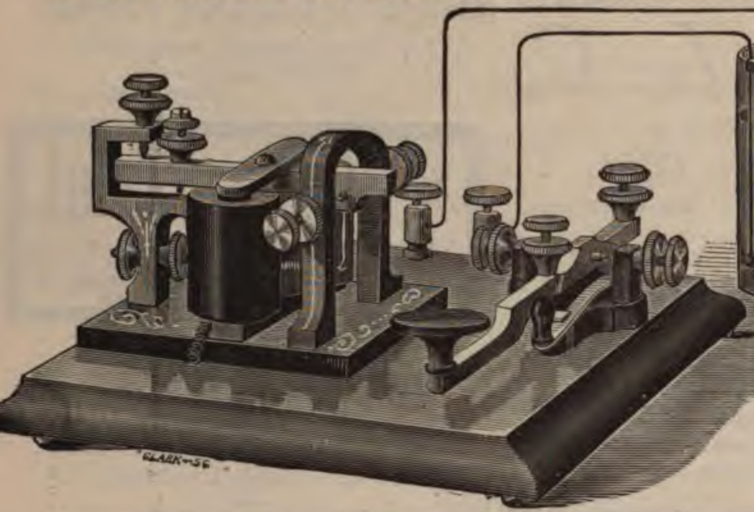

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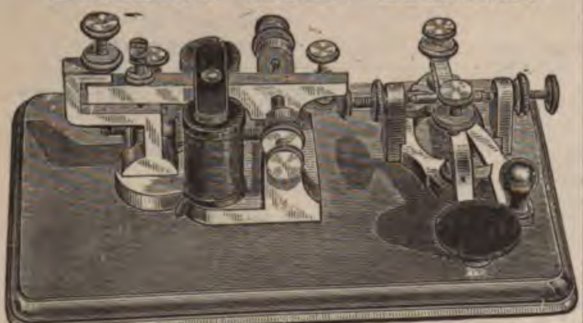

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ELECTRIC LIGHTING APPLIANCES.

THE accompanying cuts illustrate certain devices, lately patented by Mr. S. H. Tacy, of New York, and designed to protect the mechanism of arc lamps, and more effectively to utilize the light they emit, as well as to facilitate the handling of them. They show, first, a reflector, to throw downward the large proportion of light which usually escapes, uselessly, into the atmosphere; second, a hood, for the protection of the mechanism of the lamp from rain and snow; third, a suspension carriage with an automatic hook attachment, to catch and sustain a hanging lamp; and fourth, an improved lamp-post mounting.

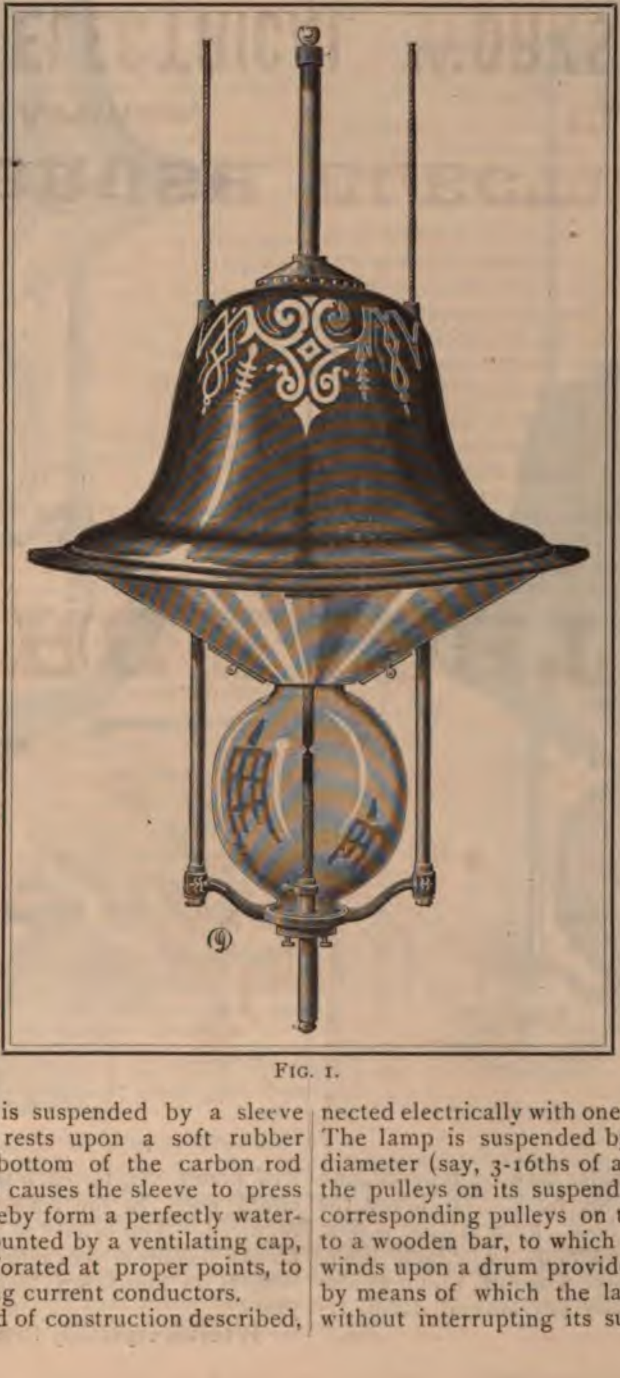

FIG. 1.

The advantage of a reflector above the lamp is suggested by frequent attempts to employ it, but the trouble it causes has heretofore been an impediment to its successful use.

The one here shown, is made of silvered glass, in two sections, which, when disconnected, hang from *open* or hook hinges, upon opposite sides of a large bell-shaped cover, from which they may be easily unhooked and removed, but when closed together, they are fastened by sliding bolts, and, thus united, they form a perfect inverted concave or convex cone, through holes in which the carbon and side rods of the lamp pass freely.

The bell-shaped cover, designed to protect the reflector and mechanism of the lamp from rain and snow, is made of linen paper, the material used for constructing paper boats, domes of large buildings, etc., because it is a very light, tough, and perfectly waterproof fabric, capable of withstanding hard usage, yet susceptible of a high polish, and of being easily ornamented. The bell is suspended by a sleeve at its top, the edge of which rests upon a soft rubber ring, or piece of tubing, at the bottom of the carbon rod tube, and the weight of the bell causes the sleeve to press upon the rubber ring, and thereby form a perfectly water-tight joint. The bell is surmounted by a ventilating cap, and, for hanging lamps, is perforated at proper points, to permit the passage of the lighting current conductors.

In consequence of the method of construction described, the hood and reflector may be fixed upon a lamp without taking the lamp apart, and the reflector may be removed to permit access to the lamp's mechanism; but, to replace the upper carbon, it is only necessary to lift up the reflector and cover together, until they are caught by a spring hook, which is so situated upon the case of the lamp's mechanism as to catch the edge of the opening in the reflector, and sustain it. This opening in the reflector, when it is lowered, encircles the neck of the globe, so that if the lamp swing out of the perpendicular, and the globe be displaced, it will hold it and prevent it from striking the carbons, but being a little larger than the neck of the globe, an annular opening is left, through which cold air constantly enters the hood from below, to replace the heated air which escapes from the ventilator above, and thus is maintained a draught which carries hot particles, detached from the carbons, up into the hood, where they remain. The hood, therefore, performs the additional function of a spark arrester.

An automatic hook, designed to catch and sustain a hanging lamp, which it is necessary to raise into position by cord and pulley, is shown in Fig. 2. It is especially convenient when the lamp is to be suspended from a horizontally stretched wire, as, for instance, in case of a lamp hung over the middle of a railroad yard from a wire stretched between poles upon opposite sides of the tracks. To the wire is attached a carriage, in the form of a cross; at the ends of its transverse arm are suspended two insulated grooved brass pulleys, which correspond with a similar pair attached by a cross arm upon one of the poles. These are also insulated from each other, but each is connected electrically with one of the lighting current conductors The lamp is suspended by two copper cables of suitable diameter (say, 3-16ths of an inch), which pass first through the pulleys on its suspending carriage, thence through the corresponding pulleys on the pole, and are finally attached to a wooden bar, to which is fastened a cotton rope which winds upon a drum provided with a crank and ratchet stop, by means of which the lamp may be raised and lowered without interrupting its supply of current.

The suspending wires of the lamp, shown in Fig. 2, are fixed to an arm transverse to the lamp frame, in order that the shadow of the frame may be projected across, instead of parallel with, the rails. In the centre of the cross thus formed, a hinged hook is firmly held, vertically, or at any desired angle, by a screw and nut adjustment, and is so set that when the lamp is raised it strikes the lower curved edge of an oblong casting, which causes the lamp to tilt, and the hook, rising still higher, slips into a triangular hole in the oblong casting, when the strain on the cables may be relieved, and the lamp remain suspended by the hook. To lower the lamp, it is first raised, and the hook, by a similar action, is tilted out of the top of the opening. The lamp being then lowered, the hook falls upon a flange, which guides it to one side of, and effectually prevents it from re-entering the opening.

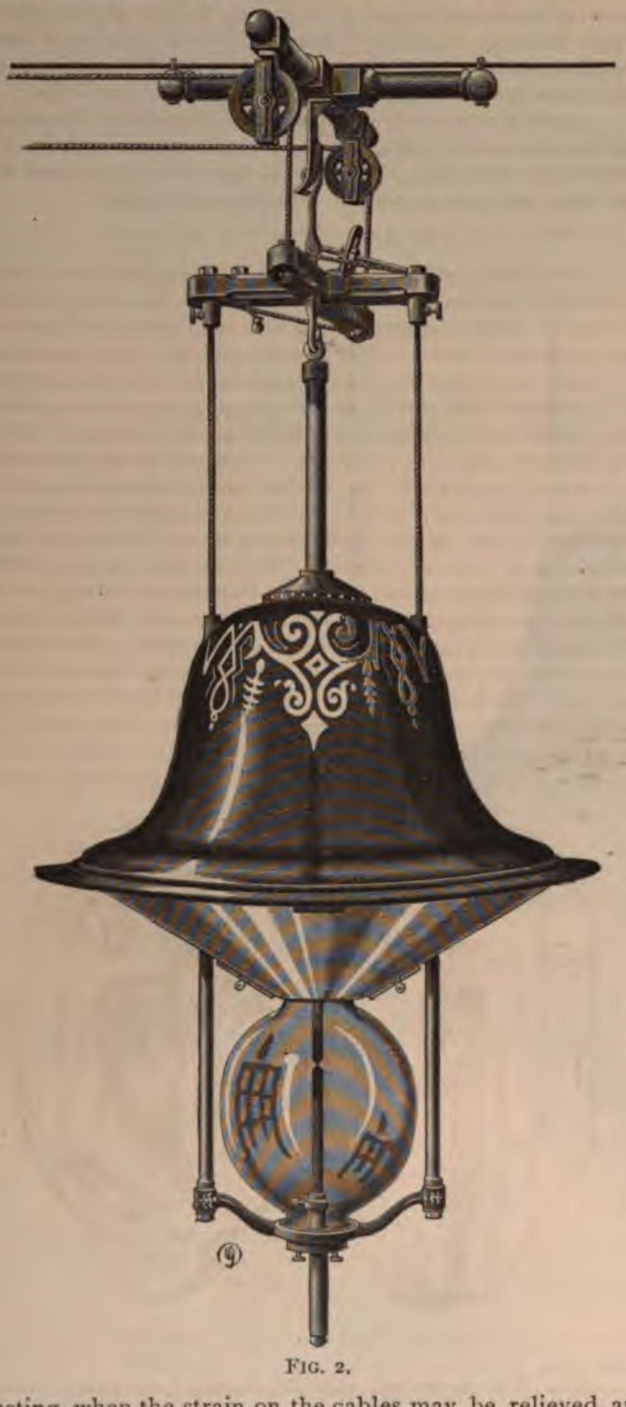

FIG. 2.

The Lehigh Valley Railroad Company adopted this as the most suitable method of suspending the forty electric lamps which they have recently provided to illuminate their immense shifting yard at Packerton, near Mauch Chunk, Pa. The yard contains from 6 to 24 tracks, running side by side, and extends a distance of 4 miles in length. Over this space the lamps are distributed, yet a man and boy trim the 40 lamps, walking, meanwhile, over the whole distance in about four and a half hours. If, to reach these lamps, it were necessary to climb poles in the usual way, much more time would be required. The beauty of the illumination obtained by this means, has been the subject of much comment from passengers on the New Jersey Central Railroad, and the local press.

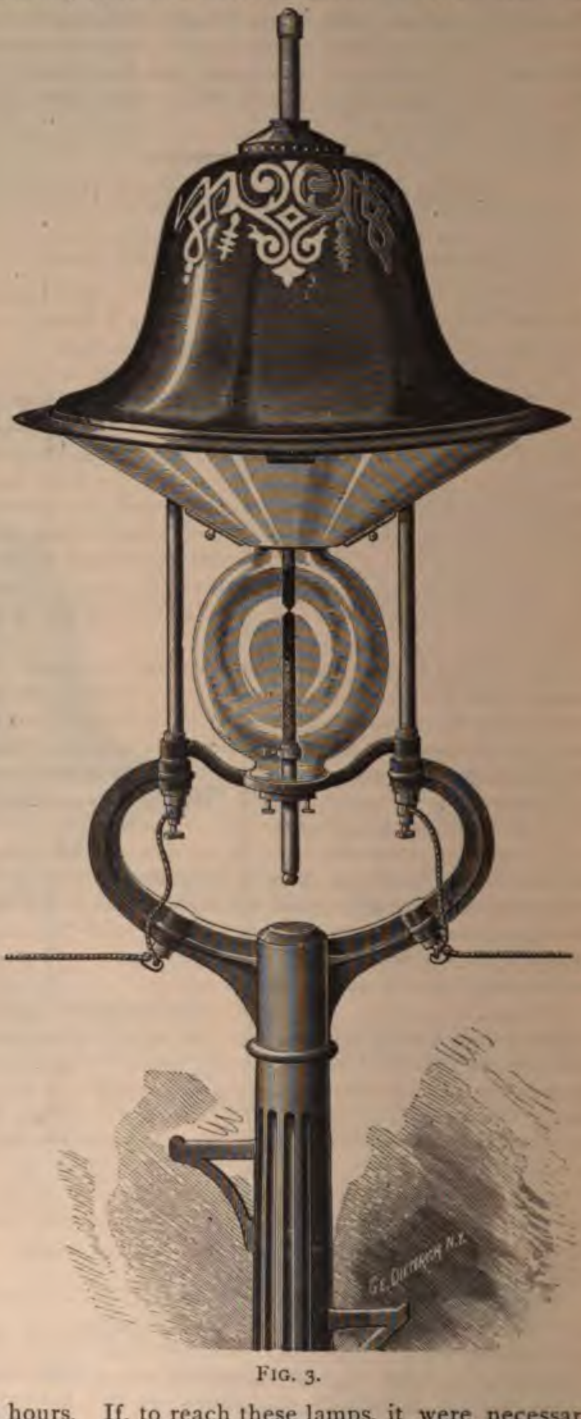

FIG. 3.

It seems especially to indicate that a much larger proportion of light is obtained than by the usual method of mounting on poles; but since the ordinary mounting is less favorable, chiefly because the supporting frames employed intercept the light, Mr. Tacy has designed a post mounting with base connection for the lighting current cables, shown in Fig. 3, which avoids all obstacles to the light except two slender side bars.

Some light necessarily passes up into the interior of the dome-shaped cover of the lamp thus arranged. This it is proposed to use, to show, in brilliantly illuminated letters, the names of the streets, painted upon glass strips covering openings in the sides of the hood, and thus restore to the public a familiar convenience of which they have been for some time deprived.

HISTORICAL NOTES IN PHYSICS.

I.—THE DISCOVERY OF THE ELECTRIC LIGHT.

IN looking through an old volume of the *Journal de Paris*, I came across the following entry, for the date 22 Ventôse, An X. (March 12, 1802), which clearly relates to an exhibition of the electric-arc light:

"Le citoyen Robertson, auteur de la fantasmagorie, fait dans ce moment, des expériences intéressantes, et qui doivent sans doute avancer nos connoissances sur le *galvanisme*. Il vient de monter des piles métalliques, au nombre de 2500 plaques de zinc, et autant en cuivre rosette. Nous parlerons incessament de ses résultats, aussi que d'une expérience nouvelle qu'il a faite hier avec deux charbons ardens. Le premier étant placé à la base d'une colonne de 120 élémens de zinc et argent, et le second communiquant avec le sommet de la pile, ils ont donné, au moment de leur réunion, une étincelle brillante, d'une extrême blancheur, qui a été aperçue par toute la société. Le citoyen Robertson répétera cette expérience le 25."

The individual who thus came before the public was named Étienne Gaspard Robertson, a name suggestive of Scotch descent. He was better known for his "Phantasmagoria," exhibited a few years later in London. Of this invention a notice appears earlier in the volume from which the above passage is taken; and in an earlier volume of the *Journal de Paris* in the month "*Fructidor*, An viii.," there occurs a mention of some of his experiments on the *couronne de tasses* of Volta.

It is worthy of casual notice that in the number where Robertson's "Phantasmagoria" is advertised, the very next advertisement on the page is one of an exhibition to be given by Citoyen Martin at the Hôtel de Fermes, wherein as part of a "spectacle extraordinaire et amusant de physique," &c., was to be shown "l'expérience du télégraphie plus rapide que la lumière, d'un effet extraordinaire et amusant."

The usual date given for the invention of the electric light by Sir Humphrey Davy is 1809; but I was aware that earlier notices existed both in Cuthbertson's *Electricity* (1807), and other works. I was also under the impression that some earlier reference to the matter existed in Davy's own works. The finding of this notice in the *Journal de Paris* induced me to consult the early volumes of the *Philosophical Magazine*, and of *Nicholson's Journal*.

In the *Philosophical Magazine*, vol. ix., p. 219, under the date February 1, 1801, the following passage occurs in a paper by H. Moyes, of Edinburgh, in which experiments with a voltaic pile or column are described:

"When the above column was at the height of its strength its sparks were seen in the light of the day, even when taken with a piece of charcoal held in the hand."

In the *Journal of the Royal Institution*, vol. I (1802), Davy describes (p. 106) some experiments on the spark yielded by the pile, and states: "When, instead of the metals, pieces of well burned charcoal were employed, the spark was still larger and of a vivid whiteness." On p. 214 he describes and depicts an "apparatus for taking the galvano-electrical spark in fluids and aëriform substances." This apparatus consisted of a glass tube open at the top, and having a tubulure at the side through which a wire tipped with charcoal was introduced, another wire, also tipped with charcoal, being cemented in a vertical position through the bottom.

But earlier than any of these, is a letter printed at p. 150 of *Nicholson's Journal*, for October, 1800. This letter is entitled "Additional Experiments in Galvanic Electricity, in a Letter to Mr. Nicholson." It is dated "Dowry Square, Hotwells, September 22, 1800," and is signed by Humphrey Davy, who at that time was assistant to Dr. Beddoes, at the old Philosophical Institution in Bristol. The letter begins thus:

"SIR,—The earlier experimenters on animal electricity noticed the power of well burned charcoal to conduct the common galvanic influence. I have found that this substance possesses the same properties as metallic bodies in producing the shock and spark[1], when made a medium of communication between the ends of the galvanic pile of Signor Volta."

In none of these extracts, however, is anything said of the properties of the *arc* as a *continuous* luminous spark. These were made known in Davy's later researches. Yet the electric light attracted attention as we see before the special property of continuity was observed.

II.—THE INVENTION OF THE TELEPHONE.

In the *Journal of the Physical Society of Frankfort-on-the-Main*, for 1860–'61 (p. 57), may be found a memoir on telephony, by the galvanic current, in which its writer says: "I have now succeeded in constructing an apparatus, by means of which I am in a position to reproduce the tones of divers instruments, and even to a certain degree the human voice." The inventor further says: "Since the length of the conducting wire may be extended for this purpose just as far as in direct telegraphy, I give to my instrument the name 'telephone.'" Towards the end of the memoir it is stated, that until now it had not been possible to re-produce the tones of human speech with a distinctness sufficient to satisfy everybody: "The consonants are for the most part tolerably distinctly re-produced, but the vowels not yet to an equal degree." The author of the memoir, in which these remarkable statements occur, was Philipp Reis. The paper from which the preceding quotations have been taken contains many other points of interest, and in particular, a comparison of the action of the transmitting part of the instrument with that of the human ear, upon which it was founded. The author says: "How could a single instrument re-produce at once the total action of all the organs operated in human speech? This was ever the cardinal question. At last, I came, by accident, to put this question another way. How does *our ear* perceive the total (or resultant) vibrations of all the simultaneously operant organs of speech?" He then goes on to describe the action of the auditory ossicles, when made the recipients of sound waves, and points out how they execute movements and exert forces upon one another, in proportion to the condensations occuring in the sound conducting medium, and to the amplitudes of vibration of the

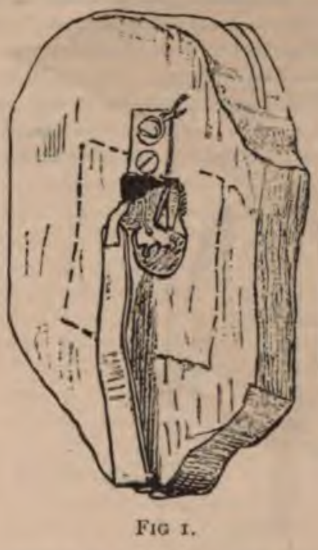

FIG 1.

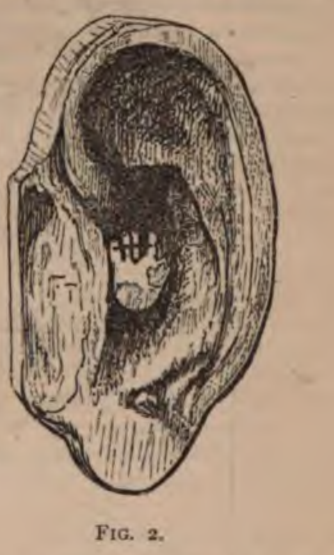

FIG. 2.

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[1] Here Davy adds a foot note: "The spark is most vivid when the charcoal is hot."

tympanum. Having stated this law of proportion between the cause and its effect, he goes on to speak of the graphic method of representing varying forces, such as those of sound waves, by curves ; and emphatically lays down that the ear is absolutely incapable of perceiving anything more than can be expressed by such a curve. After giving samples of undulatory curves corresponding to musical tones and to discordant sounds, he makes the following significant remark : "So soon, therefore, as it is possible, at any place, and in any manner, to set up vibrations, whose curves are like those of any given tone or combination of tones, we shall then receive the same impression which the tone, or combination of tones, would have produced upon us. Taking my stand upon the preceding principles, I have succeeded in constructing an apparatus," etc. He concludes his paper by saying that the newly invented phonautograph of Duhamel may, perhaps, afford evidence as to the correctness of the views which he has asserted, respecting the correspondence between sounds and their curves.

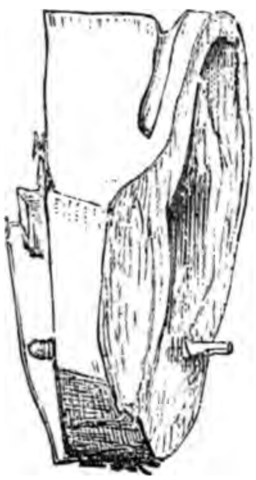

FIG. 3.

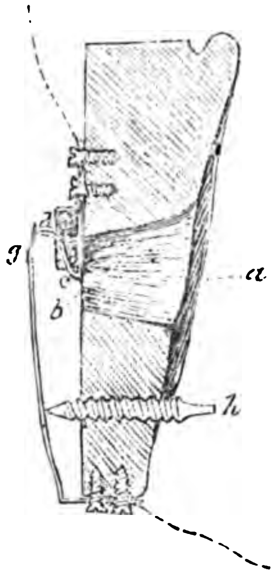

FIG. 4

The actual apparatus, figured in this memoir, and exhibited to the Frankfort Society, in October, 1861, is now in my possession ; and I have also temporarily intrusted to me a still earlier experimental telephone, made by Philipp Reis, in the form of a model of the human ear.[2] This interesting instrument is depicted in its actual condition and size, in Figs. 1, 2, and 3, and in section, in Fig. 4. It is carved in oak wood. Of the tympanic membrane only small fragments now exist. Against the centre of the tympanum rested the lower end of a little curved lever of platinum wire, which represented the "hammer" bone of the human ear. This curved lever was attached to the membrane by a minute drop of sealing-wax, so that it moved in correspondence with every movement of the tympanum. It was pivoted near its centre by being soldered to a short cross wire, serving as an axis. The upper end of the curved lever rested in loose contact against the upper end of a vertical spring, about one inch long, bearing at its summit a slender and resilient strip of platinum foil. An adjusting screw served to regulate the degree of contact between the vertical spring and the curved lever. Conducting wires, by means of which the current of electricity entered and left the apparatus, were affixed to screws in connection, respectively, with the support of the pivoted lever and with the vertical spring.

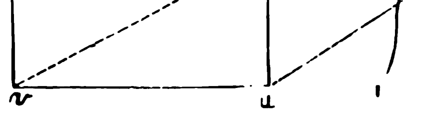

FIG. 5.

If now any words or sounds of any kind were uttered in front of the ear, the membrane was thereby set into vibrations, as in the human ear. The little curved lever took up these motions precisely as the "hammer" bone of the human ear does ; and, like the "hammer" bone, transferred them to that with which it was in contact. The result was that the contact between the upper end of the lever and the spring was caused to vary. With every rarefaction of the air the membrane moved forward, and the upper end of the little lever moved backward and pressed more firmly than before against the spring, making better contact, and allowing a stronger current to flow. At every condensation of the air the membrane moved backward, and the upper end of the lever moved forward, so as to press less strongly than before against the spring, thereby making a less complete contact than before, and by thus partially interrupting the passage of the current, caused the current to flow less freely. The sound waves which entered the air would, in this fashion, throw the electric current, which flowed through the point of variable contact, into undulations in strength. Reis, himself, termed the contact part of his telephone an interrupter. That it was not intended to operate as an abrupt make-and-break arrangement, as some persons have erroneously fancied, is evident ; firstly, because the inventor introduced delicate springs to give a following contact, and so prevent abrupt breaks from occurring ; secondly, because abrupt breaks would have violated the fundamental principle to which he refers in the sentence immediately preceding his description of the instrument shown to the Frankfort Society, namely that of creating tones whose curves were like the undulatory curves imparted at the transmitting end of the instrument ; thirdly, because (in another article) he described his instrument as opening and closing the circuit in proportion to the sound wave, which obviously an abrupt "break-and-make" apparatus without a spring contact could not possibly do. The mechanism which Reis thus invented—and which is substantially alike in all his instruments—might be appropriately described as the combination of a tympanum with an electric current regulator, the essential principle of the electric current regulator being the employment of a loose or imperfect contact between the two parts of the conducting system, those parts being so arranged that the vibrations of the tympanum would alter the degree of contact, and thereby vary the resistance offered at the point of contact to the passage of the current, and so regulate the strength of the current that it should magnetize and demagnetize the core of a distant electro-magnet in a manner, corresponding to the undulations of the tympanum of the transmitter.

The particular form of the instrument shown at Frankfort, in 1861, and described in the *Journal*, is somewhat different from the "ear." The Fig. 5, and description are taken from the *Journal :*

"In a cube of wood, *r s t u v w x*, there is a conical hole, *a*, closed at one side by the membrane *b* (made of the lesser intestine of the pig), upon the middle of which a little strip of platinum is cemented as a conductor of the current. This is united with the binding screw, *p*. From the binding screw, *n*, there passes likewise a thin strip of metal over the middle of the membrane, and terminates here in a little platinum wire, which stands at right angles to the length and breadth of the strip. From the binding screw, *p*, a conducting wire leads through the battery to a distant station."

In the original instrument there is also an adjusting screw to regulate the contact, though this is not shown in the drawing.

The receiver used to reproduce the sounds transmitted by these telephones, is also described in the memoir of Reis. It consisted of a steel needle surrounded by a coil of wire. This was at first set up for the purpose of increasing the sounds by resonance, upon the top of a violin; later it was mounted upon a pinewood box, to which still later a lid of thin pine was added against which the listener could press his ear. The sounds emitted by such a wire during magnetization and demagnetization were well known before; but to Reis is due the discovery that other tones than the natural vibration tone of the wire, could be electrically imposed upon it by the varying magnetizing force of the current in the surrounding coil. Reis explained the reproduction of the transmitted sounds by supposing a magnetic attraction between the atoms of the steel wire to work synchronously with the fluctuations of the current. He later devised a different receiver in which an electro-magnet was provided with an elastically mounted armature of iron which it threw into vibrations corresponding to those of the original sound waves. With this apparatus and a transmitter with a small curved lever, like that in the "ear," he was able (see Kuhn's *Handbuch der Angewandten Elektricitätslehre*, 1866, p. 1021) not only to reproduce melodies with astonishing exactness, and single words as in speaking and reading (less distinctly), but even to transmit the inflexions of the voice expressive of surprise, command, interrogation, &c.

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[2] The property of M. Léon Garnier, Director of Garnier's Institute at Fredrichsdorf, near Homburg, where Philipp Reiss was formerly Teacher of Natural Sciences.

Considering how far these early researches were carried, it is remarkable that their historic value has been so greatly overlooked.

SILVANUS P. THOMPSON, *in Nature*.

PRACTICAL TELEPHONY.

THE LEADING-IN WIRES.

FOR this purpose No. 18 B.W.G. copper wire, covered with two coatings of gutta percha to a total thickness of No. 7 B.W.G. wound with strong tape, and, lastly, well covered with Stockholm tar, should be used. These wires should be re-tarred at frequent intervals, to keep them in good condition. Paint is injurious to gutta percha. Messrs. Henley & Co. have lately introduced the ozokerit core, which has a slight advantage as regards price, whilst its durability is guaranteed to exceed that of gutta percha. Subjoined is a test of this core by the electrician of the general post-office, W. H. Preece, Esq., F. R. S.:

Conductor resistance	23.723 ohms.
Capacity.........................	.281 microfarad.
Insulation.............	8.196 megohms.
Temperature......................	75° Fah.

Tests of gutta percha core of similar length :—

Conductor resistance........... ..	22.36 ohms.
Capacity.........................	.273 microfarad.
Insulation.............	.860 megohms.
Temperature ... ,.	75° Fah.

It will be seen by this that its insulation is very high, and if it prove to be more durable for telephone leads than gutta percha (which at best is comparatively short-lived when exposed to the air), it should come into general use. It is made by forcing melted ozokerit paraffine into ordinary rubber core under heavy pressure. It would be more economical in the end if the leading-in wires were double-taped; they would then be better able to withstand the rough usage to which they are often subjected from the line men's feet when going up and down the poles, etc. Care should also be taken that a spare piece of gutta percha is wound round them where they touch corners of chimneys, walls, etc. The lead should make a short dip below, and then rise to the hole, where it enters the wall or window frame, so that rain may run down and drip off at the bend instead of running into the building.

Where possible, connect the main gutta percha lead direct to the instrument, it being much less liable to damage. In some cases this may be inadmissable from its unsightliness, when the lead must be joined to the ordinary paraffined wire, and the joint soldered with composite candle or resin. *Never use spirits.* When soldered, the joint should be wrapped with tarred or india-rubber tape, to prevent contact with other wires.

It may be as well to give instructions here how to solder a joint properly, a very easy operation in itself, although neglected by many fitters. The following articles must be provided: A small spirit lamp; a small copper bit made from about 2 in. of No. 8 copper wire, drawn to a blunt point at one end, with a steel wire screwed into the other, and this wire driven into a brad-awl handle; a small tin box to hold a short piece of composite candle or powdered resin; and, lastly, a small quantity of the best blowpipe solder. The iron, when new, and at intervals afterwards, will require tinning, which is done thus: Make the iron bright with emery paper, heat it in the spirit lamp, and rub it on a piece of tin with a small piece of solder and composite or resin. This should give it a bright tinned surface. Now, to solder a joint. Scrape the wires bright, twist them firmly together, rub well over with composite, or dust the joint with powdered resin, heat the bit in the lamp, wipe the point with a piece of rag, touch it on the solder so that a small piece adheres, and apply it to the joint, rubbing it along. If this is properly done, a strong, clean joint is the result. This small copper bit is sufficient for the small wires used indoors for telephonic purposes.

TERMINAL BOARD FOR SWITCH ROOM.

Figures 1, 2, 3, show a convenient terminal board for the leading-in wires. The main board is 6 feet by 3 feet, the terminals are double headed and 3 inches apart in the rows, and the rows 3 inches from each other. The board D is 9 inches wide, and the holes half an inch apart in the rows, and the rows 3 inches apart; in the board E, the holes are half an inch apart both ways. This board will accommodate 200 lines. Each terminal should be plainly numbered on the board on both sides. If the terminal board can be placed in the roof space instead of in the switch room so much the better. The line-man has only to place the gutta percha lead under the desired number. The connections should be complete down to the switch room, and the annunciators in place when the board is first fixed. This saves the instrument fitter visiting the switch room each time a new subscriber is connected.

THE EARTH WIRE.

Too much importance cannot be attached to having a good earth connection, by means of which the circuit is completed. Some people seem to have an idea that any flimsy attachment, such as twisting a wire round the nearest gas bracket, is sufficient. This, if it answers for a time, is only at the expense of extra battery power, and in all probability causes trouble in calling the exchange, there not being sufficient current passing to drop the annunciator shutter, so, by all means, have a good earth.

If possible, run a gutta percha wire (as used for leads) to the water main (*not a cistern pipe*), scrape the pipe clean, wind the wire (bared of the gutta percha) at least six or eight times round the pipe, bind tightly by drawing the free end under the last three or four coils, and have the whole well soldered together. Failing this, attach to the main gas pipe, *the street side of the meter* (if on the house side the meter must be bridged over with another piece of wire firmly bound, and soldered on each side), owing to the white or red lead used in the pipe joints making a very bad electrical connection, and composition (*i. e*:, lead) gas pipes should on no account be used. If economy (?) forbids the use of gutta percha covered wire for the earth connection, it is better to use No. 14 or 16 bare copper wire than the small paraffined wire used in connecting up the instruments, because, in all probability, in getting to the water main, the wire must pass places where it will be liable to injury from dampness and other causes; 3-16 galvanized line wire may also be used. If forced to use paraffined wire, a stout wire must be soldered to the water pipe, and the other wire spliced and soldered to it.

It will in most cases be sufficient, if the stout wire used for the earth connection starts from the zinc end of the battery. The connection from the zinc to the instrument can be made with paraffined wire.

THE EARTH CONNECTION FOR EXCHANGES.

If it is so important to secure a good earth on ordinary lines, the same holds good with, if possible, increased force to exchanges, for in the case of the ordinary line that only suffers; but if the exchange earth fails, perhaps 500 to 1,000 lines are affected. It is, therefore, advisable to have several earth connections at various points. If possible, a large copper wire, such as No. 6 B. W. G., should be used. This should be firmly soldered to both gas and water pipes (on the street side of the meter in the case of gas pipes). Do not trust to any bridging, or any makeshift contrivance, and then there will be no risk of having all the exchange business brought to a stand from "bad earth."

It may sometimes occur that an "earth" has to be obtained where there are no water or gas mains. In this case search must be made for a pump pipe leading into a well, which will make a good "earth." Failing this, however, an artificial earth must be made thus: Dig a hole about four feet deep in moist soil (it need not be larger than will enable the workman to use his tools). Take a strip of about 4lb. of sheet lead, six inches wide and five feet long. Suspend this in the centre of the hole, and fill the hole with tightly packed gas coke to within six inches of the surface, then fill with the soil to the surface level; the wire must then be soldered to the projecting end of the lead strip.

LIGHTNING ARRESTERS.

If these are used, the earth wire in connection with them should, preferably, be separate from the battery earth wire. It should also consist of No. 16 wire right through, or it will be practically useless. It must be well soldered to the main gas or water pipe.

Although, as a rule, in England, lightning arresters are seldom used in exchanges, it may be useful to some who may be engaged in other countries, where they are absolutely necessary, to know how to protect the instruments under their charge. In the first place, supposing there are no arresters, and warning is given of the approach of a storm, a stout copper wire may be twisted round terminal after terminal all over the terminal board. This, however, stops all operations in the exchange, and must be removed directly the storm is over. The best plan is to insert an arrester to each terminal on the terminal board. A simple arrester may be made thus: Take two pieces of No. 16 double silk covered copper wire, each 6 inches long, and preferably of different colors, twist them firmly together, taking care that the bare ends do not touch each other, test them carefully to see that no leakage takes place between them, fix one end of one wire under the terminal on terminal board, and the end of the other wire to earth. Fig. 4 gives the ideal plan. The two spare ends may be prevented from coming into contact by a covering of sealing wax or shellac. Each line will, of course, require an arrester. Of course more efficient arresters can be used, but with hundreds of lines the expense is a serious consideration.

The line or earth wires must not be allowed to pass too near lead gas pipes (six inches should be the least distance), as a spark may jump across, fuse the pipe, and fire the gas This has actually occurred. It should also be remembered that the inductive charge caused by thunder clouds passing over the wires is often powerful enough to fuse the coils of the bells or annunciators, and that short lines are more apt to be affected than long ones.

Lastly, if arresters be used, see that they are carefully made and tested, as there is a risk of communication being interrupted by their leakage to earth.—*London Electrician.*

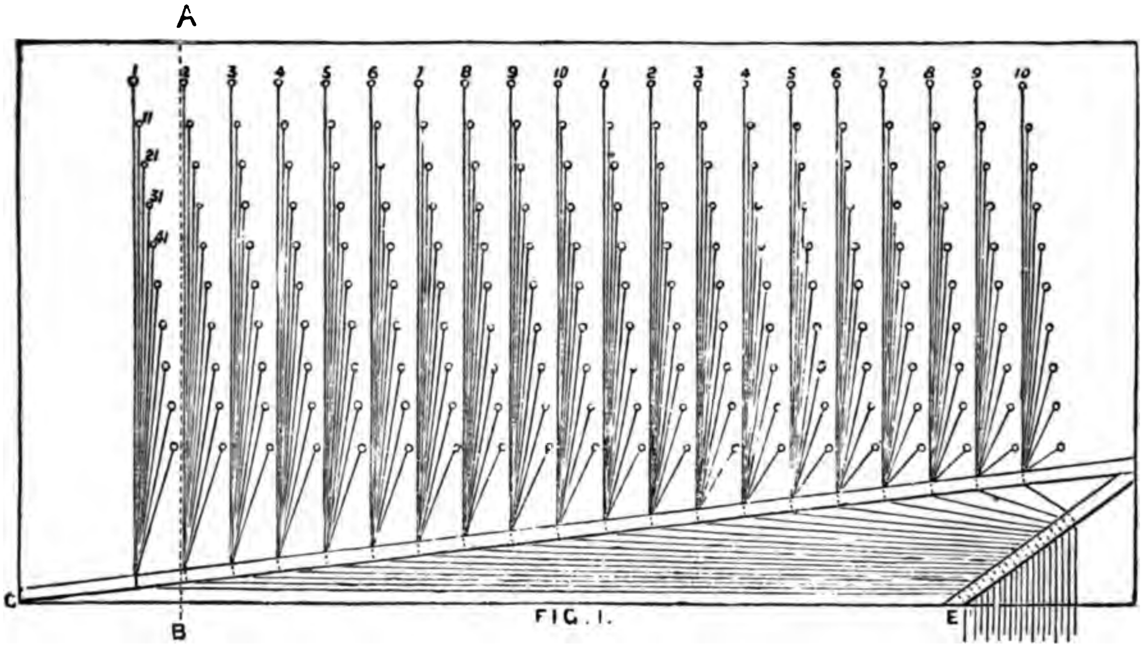


FIG. 1.

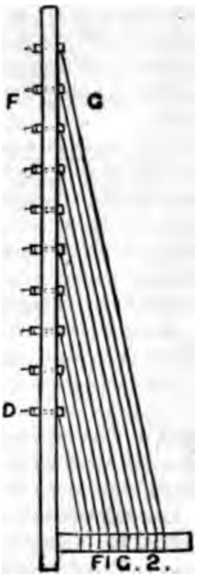


FIG. 2.

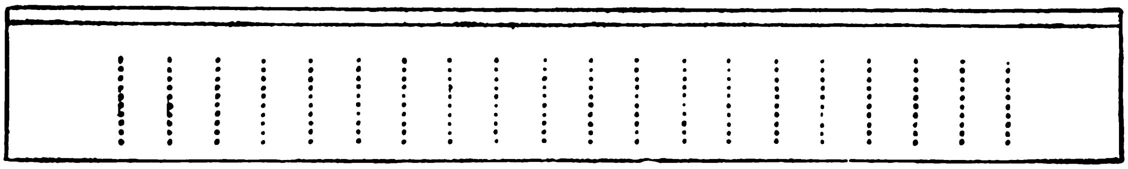


FIG. 3.

FIG. 1.—ELEVATION OF SWITCH BOARD. FIG. 2.—SECTION OF SWITCH BOARD AT A B. FIG. 3.—PLAN OF SWITCH BOARD AT C D.

In some cases, where the line is short, it may be cheaper to run a second wire and use a metallic circuit.

When testing your earth, test by ringing the bell, and not by the telephone, because the telephone will speak with an "earth" so defective and of such high resistance that the bell could not be made to ring through it.

If it can possibly be avoided, do not have the earth connection on a water main at one end, and on a gas main at the other, as permanent currents are thereby often set up.

THE JOINING-UP WIRES.

These usually consist of No 20 B. W. G. copper wire, having a number of cotton threads laid up parallel with it, the whole well served or bound round with other threads in two colors, so as to show in bands alternately; the whole well saturated with paraffine, and polished by friction. This answers the purpose very well, but the insulation is not proof against wet (especially sal-ammoniac solution), therefore, in joining up the battery, take care that the wires or terminals are not wetted by splashing or otherwise, or a fault, or possibly several, will be surely developed in time.

Do not join the wires unless the joints be soldered; joining is seldom necessary, if a wire should be cut too short do not use it, cut another. The short one will come in another time, and, lastly, *never put two wires under one staple, or allow two staples to touch each other.*

In removing the covering from this or any covered wire, never cut square through the covering, but draw the knife parallel with the wire. The first method in all probability makes a slight nick on the wire, and if this is done the wire will come asunder there if slightly bent, and consequently cause a fault.

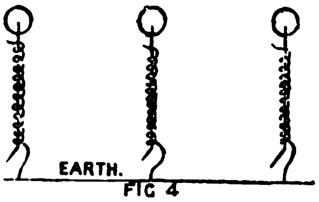


FIG 4

ON THE APPLICATION OF ELECTRICITY TO THE BLEACHING OF TEXTILE FABRICS MADE OF VEGETABLE FIBRE.

(From *Le Génie Civil.*)

IT is generally recognized, that chemical substances, in the nascent state, are characterized by affinities especially energetic, and the results of numerous experiments accord with the statement, that vegetable and animal fibres are rapidly bleached when they are brought into contact with oxides and chlorides which evolve their oxygen and chlorine in the nascent status, when submitted to electrolysis.

The coloring matter which impregnates the majority of vegetable textile fabrics, such as cotton and linen goods (to mention only those most commonly used), is, in effect, completely destroyed only by the combined action of oxygen and chlorine, which act always in the same manner, whether the fibres be in the raw state, or woven in threads or tissues.

In the application of electrolysis to the bleaching of textile material, it suffices to immerse, in the decolorizing solution, the electrodes of a sufficiently powerful generator of electricity.

The fibres to be bleached must be immersed in the same solution, which consists, invariably, of water, holding in solution, as the case may be, hypochlorites in general, chlorides, bromides, or iodides adapted to evolve chlorine, bromine, or iodine, in the nascent state. The nascent substances thus evolved, generally in the gaseous condition, perform the function of oxidizing or decolorizing agents.

The fibres immersed in the bleaching solution during the passage of the electric current, must necessarily remain in it a greater or less length of time, according to the nature of the material to be bleached, and, upon the termination of this first operation, must be removed, washed, rinsed, and dried.

The employment of an electric current to decompose the metallic chlorides and dissociate their elements, the metals and chlorine, is by no means new, and, up to this time, the alkaline hypochlorites obtained by well-known methods, have been more especially employed. The metal is oxidized in presence of the water, which is indispensible to the operation, but the results obtained, in decolorizing effect, by the method thus conducted, are deceptive. It is evidently more rational and economical to seek to form the hypochlorite directly, by borrowing its elements from the metallic chloride itself, and from the water, by means of which the transformation is effected. It is, in fact, reversing the method; and to thus synthetically accomplish its results, an apparatus has been devised by Messrs. Naudin and Schneider, of Paris, to which we invite the attention of the reader.

If a solution of sodic chloride, or cooking salt, Na. Cl., be submitted to electrolysis, in a vessel hermetically sealed and containing the articles to be bleached, the formation of sodic hypochlorite results, according to the following equation:

$$2\ \mathrm{Na.\ Cl.} + 2\mathrm{H_2O.} = \mathrm{Na.\ Cl.} + \mathrm{Na.\ O,\ ClO.} + 4\mathrm{H}$$

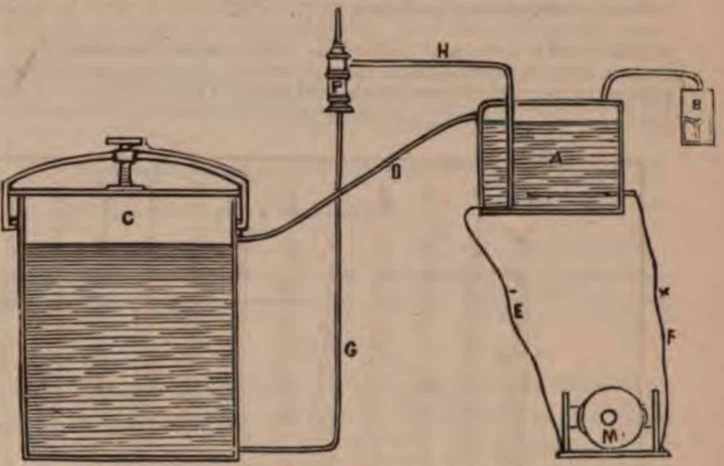
Operating in this manner, we have the advantage of the action of nascent substances produced by the electrical double decomposition of sodic chloride and water, which causes the simultaneous disengagement —chlorine, hydrogen, oxygen, and the metal.

The textile fabric is decolorized by the combined action of oxygen and chlorine.

Starting with this fundamental idea, it is appropriate to employ the arrangement of Naudin and Schneider.

The apparatus consists of an electrolyzer, A, hermetically closed. The electrodes, E and F, of any electric machine whatever, M y, enter its lower part. The receiver, A, is provided with a safety tube, T, leading from its upper part to a reservoir, B; a second tube, D, serves for overflow, and leads to the tub, C. The liquid contained in this latter reservoir is raised through the tube, G, by the pump, P, and is forced through the tube, H, into the lower part of the electrolyzer, A.

The action of the apparatus is as follows: The closed reservoir, C, in which the materials to be bleached are immersed, is filled, together with the electrolyzer, A, with a solution of sodic chloride. In the latter, this solution is submitted to electrolysis, and, in consequence of the electrochemical decomposition of the chloride and the water, their elements in the nascent state constitute the hypochlorite of sodium. When the partial or total transformation of the liquor is effected, as indicated by suitable chlorometric determinations, the pump, P, is operated rapidly, and transfers solution of sodic chloride from the bottom of the vat, C, to the bottom of the electrolyzer, A.



APPARATUS OF NAUDIN AND SCHNEIDER.

In consequence of the rise in level of the liquid in A, by the addition from below of fresh solution, the hypochlorite formed flows through the pipe, D, and diffuses through the solution in C, when it comes into contact with the material under treatment. The safety tube, T, adapted to the electrolyzer, allows the hydrogen, produced by the chemical reaction, to escape through an alkaline solution contained in the trap B, which, however, absorbs and retains the associated free chlorine, that would otherwise escape and incommode the operator.

It is apparent, that the slow transfer of the saline solution from the vat, C, into the electrolyzer, its rapid transformation into bleaching solution, and its prompt application to the fibres under treatment, offer important advantages.

While, in the present state of the industries, the decolorizing chlorides are employed, they are obtained by transforming sodic chloride into hydric chloride (muriatic acid), from which chlorine is disengaged by treating it with binoxide of manganese; but, by this new method, the chloride of sodium is used directly, in the form of ordinary salt water, and the hypochlorite formed from it, by a simple re-arrangement of its constituent molecules, under the influence of an electric current.

Another, and a very great advantage, of the method of electric bleaching, is that of having constantly at hand a fresh solution of hypoclorite, having a uniform decolorizing power which can be regulated at pleasure, by varying the current.

It may be remarked, that the disengagement of chlorine from all hypochlorites, either solid or in solution, requires a certain time, and that all chlorides, bromides, or iodides, which are isomorphous with sodic chloride, will undergo an analogous chemical transformation adapted to the same purpose. Among them, the potassic and baric chlorides, the strontic and calcic bromides, and the aluminic and magnesic iodides, are conspicuous.

Since the different salts contained in sea water are largely of this class, it follows that it may be directly employed in this process; and after the solution has been deprived of its chlorine, by electrolysis, it becomes a solution of caustic soda, which can be used for cleansing and scouring baths.

H. DANZIER, Civil Engineer.

—— WE HOPE TO GIVE in our next issue the description of a system recently perfected, that produces heat, power, and the electric light. It will doubtless prove of special interest to the public.

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NOTICE.

A continuation of article on "The Gold and Stock Telegraph Company," and on "Sketches of Electrical History," will appear in August number of this paper.

THE ELECTRIC LIGHT AT THE CHICAGO EXPOSITION.

THE electric light companies have taken advantage of the opportunity afforded by the National Exposition of Railway Appliances, at Chicago, to make the finest display of electric lighting that has yet been made.

Five companies exhibited their apparatus, and contributed to the lighting of the building and grounds. These were the United States Co.; the Edison Co.; the Brush Co.; the Fuller Co.; and the Thomson-Houston Co. (formerly the American Co., of New Britain, Conn.). The main building, with its various annexes, and the outside spaces, were lighted with about five hundred arc lights. Of these, the Thomson-Houston Co. furnished about thirty or forty, and the remainder were about equally divided between the Fuller, the United States, and the Brush companies. Between six and seven hundred incandescent lights were used in the small rooms and offices, and in the booths of different exhibitors, of which the Edison Co., and the United States Co., each contributed about one-half. We understand that the different companies exhibited only a limited number of lights to show the working of their apparatus, and that the remaining lights were paid for by the Exposition Association.

Although considerable trouble was experienced from deficient power, the lights, as a whole, worked very satisfactorily, and the general effect was extremely fine.

The exhibit of the United States Co. was larger and more complete, and in many respects, more attractive, than any of the others, as it embraced not only arc and incandescent lighting, but also electrical transmission of power. One of the most attractive of the exhibits was a cascade supplied with water by a centrifugal pump, driven by a Weston motor, and illuminated by Maxim incandescent lamps, placed behind the sheet of falling water. A Weston dynamo and motor were also used for running the electric railway.

The Weston arc lights and the Thomson-Houston arc lights, attracted much attention by their remarkable steadiness and high illuminating power. The Fuller lights were not so powerful, and far less steady. This appeared to be due, in great measure, to putting more lights on the machines than they could run properly. The Brush arc lights were conspicuously bad. They were feeble, uneven, and unsteady. There appeared to be a surprising lack of care in the erection and management of the Brush exhibit. The circuits were run in a very slipshod way, the lamps were placed at irregular intervals, and even the globes for the lamps were, apparently, in many instances, improvised out of porcelain shades made for argand burners.

The absence of the Brush storage battery from the exposition, was the subject of much comment. A few Swan lamps were shown, and the chandeliers upon which these were placed, were labeled "The Brush-Swan system of electrical storage, light and power," but the lamps were evidently run directly from a small Brush dynamo, and careful inquiry failed to discover any storage battery.

The Edison incandescent lights, and the Maxim incandescent lights, both worked extremely well, and the exhibition of incandescent lighting was very creditable to both companies.

The electric railway was one of the most popular features of the exposition. A circular track was erected around the gallery of the main building, and upon this was placed an electric locomotive and a car, carrying thirty or forty passengers. The current was carried to the motor on the locomotive through the rails, and a third rail placed between the two main rails. Although all the work was done hurriedly, in the last week or two before the exposition opened, and the appliances used for controlling the motor were quite crude, the railway, on the whole, worked well, and was examined with great interest by many prominent railroad men.

In the prospectus of the exposition, a gold medal was offered for the best system of lighting depots, shops and yards by electricity, and to this, were afterward added, gold medals for the best arc system and the best incandescent system. All the exhibitors, except the Brush company, entered into competition for these awards, but afterward united in requesting that thorough scientific tests and measurements of the different systems be made by an expert jury, and that the report of the jury be substituted for the awards proposed. A jury has been appointed, consisting of Prof. Henry Morton, of Stevens Institute; Prof. Charles R. Cross, of the Massachusetts Institute of Technology; Prof. B. F. Thomas, of the University of Missouri; Mr. L. F. Leyne, of the *American Machinist*, and Prof. James Denton, of Stevens Institute. The tests are to be made at New York, before the 1st of September. The Brush Co. has been invited by the other companies to join in the tests, and will probably do so.

We think the electric light companies have acted wisely in waiving the awards, and arranging for thorough tests. Nothing is more unsatisfactory than awards based upon mere cursory examination of complicated apparatus shown at an exhibition, and we feel confident that, both the public and the electric light companies, will be greatly benefited by a thorough and impartial examination of the real merits of the different systems.

The time allowed is ample for doing the work well, and we have no doubt that all the exhibitors will give the jury full facilities for an exhaustive examination. The jury is all that could be desired, both in respect to the ability and to the character of its members, and we have no doubt that its report will be received as conclusive authority.

PROFESSOR HUGHES' LECTURE ON MAGNETISM.

ONE of the most important contributions to investigations in magnetism, was lately delivered by Prof. D. E. Hughes, F. R. S., before the London Society of Telegraph Engineers and of Electricians. Prof. Hughes kindly sent us advance proofs of the lecture, but unfortunately they arrived a few days after the issue of our last number. Since then, the lecture has been given a great deal of publicity in the scientific and general press, and we are, therefore, reluctantly obliged to forego publishing it in *extenso.*

At the same time the lecture disposes in such a convincing manner of some of the old theories of magnetism in metals, that it deserves not only reproduction but discussion. To this last end we give the theory of magnetism which Professor Hughes has adopted from his own experiments:

1. That each molecule of a piece of iron, steel, or other magnetic metal is a separate and independent magnet, having its two poles and distribution of magnetic polarity exactly the same as its total evident magnetism, when noticed upon a steel bar-magnet.

2. That each molecule, or its polarity, can be rotated in either direction upon its axis by torsion, stress, or by physical forces, such as magnetism and electricity.

3. That the inherent polarity or magnetism of each molecule is a constant quantity like gravity; that it can neither be augmented nor destroyed.

4. That when we have external neutrality, or no apparent magnetism, the molecules, or their polarities, arrange themselves so as to satisfy their mutual attraction by the shortest path, and thus form a complete closed circuit of attraction.

5. That when magnetism becomes evident, the molecules or their polarities have all rotated symmetrically in a given direction, producing a north pole if rotated in that direction, as regards the piece of steel, or a south pole if rotated in the opposite direction. Also, that in evident magnetism, we have still a symmetrical arrangement, but one whose circles of attraction are not completed except through an external armature joining both poles.

6. That we have permanent magnetism when the molecular rigidity, as in tempered steel, retains them in a given direction, and transient magnetism whenever the molecules rotate in comparative freedom, as in soft iron.

"These experiments would do away with the theory of Coulomb and Poisson, that each molecule is a sphere containing two distinct magnetic fluids, and a peculiar coercive force. The theory of Ampére that elementary currents flow around each molecule was shown to be equally illusive."

The inherent polarity of magnetic metals is sought to be proved by numerous experiments. The Professor says: "We might suppose from the theory which I am advocating, that upon the rotation of the molecules there would be some disturbance or mechanical trepidation; and such is found to be the case, as first observed by Page, and afterwards verified by Dr. Youle and De la Rive, in the molecular sounds produced in iron upon its magnetization. Reis's first telephone was founded upon these sounds; and Du Moncel has made numerous researches upon this subject. In the last of my experiments, the sounds were too feeble to be heard, but by the application of the microphone these trepidations at once became audible."

Some very interesting matter is furnished by the lecture as to the molecular condition of iron, and the effect of vibration. People who distrust the metal that supports our elevated railroads, may be curious to know, that even fibrous iron may become crystallized and break in one day.

Prof. Hughes believes that he has discovered a peculiar property of magnetism; viz, "That not only can the molecules be rotated through any degree of arc to its maximum or saturation, but, that, whilst it requires a comparatively strong force to overcome its rigidity or resistance to rotation, it has a small field of its own through which it can move with excessive freedom, trembling, vibrating, or rotating through a small degree with infinitely less force than would be required to rotate it permanently on either side. This property is so marked and general that it can be observed without any special iron or apparatus."

The position maintained by the lecturer, is supported by experiments which would require to be more fully reproduced than we have space for at present, but to which we may probably return.

COMMENCEMENT EXERCISES AT THE STEVENS INSTITUTE OF TECHNOLOGY.

THE eleventh Commencement of the Stevens Institute took place in the hall of the German Club, at Hoboken, on Thursday evening, June 14th. After the customary prayer, by the Rev. S. B. Dod, President of the Board of Trustees, President Henry Morton delivered the following introductory address:

Ladies and Gentlemen:

We may, I think, regard our Commencements as annual meetings, at which we assemble to make report of the year's work, and to show you something of the product of the year's labor.

On the present occasion, I will make to you a brief report of our last year's progress, and of our next year's plans, and you will see for yourselves what is the character of the output or product of the past season.

It is an essential condition of all living bodies, that they should grow, and the measure of their vitality and healthy energy is the extent and character of that growth; and I think that we may congratulate ourselves on the extent and character of the growth of the Institute, as evidencing a vigorous vitality.

We have, in the first place, grown in numbers, having increased, since last year, about 50 per cent, or from about 100 to about 150 students.

We have also added, at the beginning of our college year, a new member to our faculty, in the person of Prof. C. A. Carr, of the U. S. Navy.

To accommodate our enlarged numbers, several alterations have been made in our building, and to afford facilities of instruction, numerous additions have been made to our machinery, apparatus, and models, for many of which additions, we have to thank some good friends of the Institute. A mere catalogue of these additions would occupy much time, and, without explanation, would convey little idea of what these acquisitions amount to.

The increase in our actual work is also seen from the list of theses by members of the graduating class, which has now reached such an extent, and numbers so many works of importance, that it would be quite impossible, within the limits of an evening, to give you even a brief abstract of them, and I must, therefore, leave you to study the mere titles on the programme, or to await the full publication of these investigations in the technical journals or hand-books; for, let me state here, that quite a number of the theses of our students are now printed and sold, by a well-known publisher, as hand-books on the special subjects about which they treat.

Besides this accomplished progress of the past year, I have also to record another important step which has been taken in reference to the immediate future.

I need not dwell on the wonderful development which the last few years have witnessed in the science of electricity, and in its applications to practice, nor point out how closely many of these applications are interwoven with the operations of the mechanical engineer.

Suffice it to say, that already electricity is an integral constituent of engineering practice, and its detailed study an essential part of a course in mechanical engineering.

Now, it is true that, from the first, the subject of electricity has held a prominent place in our course, and, that it has been very effectively taught appears from the fact that some ten or twelve of our graduates are at this moment holding responsible positions in the principal electric companies of the country. Indeed, I have it very directly from Mr. Edison himself, that two of our graduates, now with him, are the ablest and best prepared young men whom he has ever had.

It has, however, become manifest to us that, with the rapid growth in what we may call electric engineering, we ought to have a special department of applied electricity in our organization, to keep pace with the requirements of the time. The means of establishing such a department, for the time, at least, have been supplied by a good friend of the Institute; and the new department has been created by the trustees, with Dr. William E. Geyer, an old friend, and well known to most of us as the first incumbent of the chair of applied electricity.

We do not think that the time has come for organizing a special course of electrical engineering, but believe that the mechanical engineers of the Stevens Institute of Technology will, in the future, as in the past, fulfill the requirements of the profession in this, as in its other branches.

Owing to the fact that both the Society of Mechanical Engineers, and the Society of Civil Engineers, were in session in other cities, it was found impossible to secure the attendance of members of these bodies to address the graduating class. Mr. Coleman Sellers, of Philadelphia, who had been expected, telegraphed, at a late hour, that he was prevented by illness, and Prof. De V. Wood, of the Institute, consented to address the class. He spoke as follows:

I did not know until this evening, when called upon, a few minutes before 8 o'clock, to fill the place of the "distinguished visitor" upon the programme, how distinguished I was. We professional men, labor under the disadvantage that we are likely to be fluent on subjects connected with our vocations, but find it difficult to talk on others. However, it may not be inappropriate to draw upon our professional experience, on an occasion like this. Many of us, on crossing the meadows in the train, have seen great machines, into which are poured heaps of stones, which they craunch and craunch, until they turn out fragments of about the same size. There is a screen connected with the machine, which separates the product from the débris.

Now, across the way, there is another great machine, into which are poured large numbers of young men, and there is also a kind of screen they call the faculty. At first, when this machine commences to grind, there is a great deal of dust, but, in the end, it turns out lumps of about uniform quality. Ladies and gentlemen (pointing to the graduating class), you have the lumps before you, to-night, and let me tell you, in confidence, they are good lumps, carefully inspected and thoroughly approved.

You, gentlemen of the graduating class, feel proud to-night that you have passed through this ordeal and come out whole; and you have good reason to feel so. Let me say to you, as you go out from here, that you have in your keeping the credit of your *Alma Mater*. We look to you to cherish a noble pride in her reputation, and to show this to the world by your fidelity to your principles. It is especially necessary for young men, about to enter active life, to resolve to be governed by principle. The lives of many are failures, because they have not the courage to live up to their convictions. Go forth, then, gentlemen, and be assured that time and distance will not lessen the interest with which we shall watch your career.

In conclusion, let me tell the audience, confidentially, (here the Professor advanced to the edge of the stage), so that some of those behind me may not hear, who that good friend of the Institute is, who has added a department of applied electricity, at his own expense. I do not know for certain, but I have very good reasons for guessing, that this good friend is no other than President Morton.

The following is a list of graduates who received the degree of Mechanical Engineer, together with the subjects of their theses:

John B. Adger, A.M. (University of Virginia), S. C.; James Edward Sague, N. Y.:—The Construction and the Performance, as determined by Trial, of the Steamer "City of Fall River"; Morgan Brooks, Ph.B. (Brown University), Mass.; Joseph Edward Steward, N. Y.:—An Experimental Determination of the Efficiency of the Otto Gas Machine; Lewis C. Dawes, N. J.:—Improvements in the Bessemer Process; E. Duque Estrada, Cuba:—The Cuban Woods Useful in Engineering; an Experimental Investigation; Frederick C. Fraentzel, N. J.:—Wind Motors; Max Haring, Ind.:—Design of a Truss Bridge; Arthur P Henderson, N. Y.:—Steam Distribution in Marine Engines; H. Addison, Hickok, N. J.:—Apparatus for Measurement of Fluid Pressures; Franklin K. Irwin, Ala.:—Design for a Mill for the Manufacture of Cotton Goods; Frank Magee, N. J.:—Heating and Ventilating; Malcom McNaughton, N. Y:—Gas Fuel in Engineering; Harold M. Plaisted, B.M.E. (Maine State College of Agriculture and the Mechanic Arts), Me.:—Milling and its Machinery; L. Strother, Randolph, Md.: Resistance of Railway Trains; Albert B. Ropes, N. J.:—Fast Locomotives; Frederick W. Taylor, Pa.:—I. The Best Cutting Speeds of Tools Obtained by Experiment; II. Experimental Comparison of Fan and Steam Blast; James N. Warrington, Ill.:—The Screw Propeller; Ernest N. Wright, Pa.:—Commercial Efficiency of Steam Engines.

Mr. F. W. Taylor is the superintendent of the Midvale Steel Works, near Philadelphia, and he attended to his duties there at the same time that he pursued his studies at the Institute.

Graduate receiving degree of Doctor of Philosophy: Thomas B. Stillman, M.Sc. (Rutgers College), N. J.:—An Investigation of the Chemical Methods employed in the Analysis of Food.

The Priestly Prize in Chemistry has been awarded to James Beatty, Jr., member of the Junior Class (Class of '84).

In view of the excellent work performed in the Laboratory, the following members of the Class of '84 are likewise entitled to honorable mention: Wm. H. Bristol, Alvin P. Kletzsch, Lafayette D. Carroll, Harry de B. Parsons, David S. Jacobus, George F. Sandt.

The honorary degree of Doctor of Engineering, was conferred upon Mr. Leavitt, President of the Society of Mechanical Engineers.

ON THE USE OF POTTER'S CLAY AS AN ELECTRODE IN ELECTRIC THERAPEUTICS.

SOME fifty years ago, Messrs. Becquerel and Breschet observed that when an electric current is applied to the human body, it produces a kind of electrolysis in the tissues. The acids are drawn to the positive side, and the alkalies to the negative. They conceived the idea of utilizing these reactions to change the character of sores, as is done in cauterizing.

They believed that it would be sufficient, in the case of an obstinate ulcer, secreting alkaline matter, to apply the positive electrode, and by thus bringing acid elements continually on the sore, to change its nature.

When this condition should have lasted a sufficient time, the organ would be made to secrete humors of an entirely opposite character to those produced in the pathological condition, and thus gradually bring the organ into its normal state. This view was fully justified by an experiment, made in the Hôtel Dieu, by the above scientists, on a man afflicted with an obstinate ulcer. The case inaugurated a system of treatment that is known at present as the galvano-caustic chemical treatment.

The metallic electrodes—generally of platina—which are used in electric therapeutics, can very seldom be applied exactly over sores, and a layer of starch, saturated with water, or a saline solution, is placed between them and the wound. Even with this addition, however, the contact is not always perfect, and the starch has the disadvantage of drying very rapidly. Dr. Apostoli conceived the idea, some time ago, of using potters' clay, saturated with pure or salt water, as an electrode. It had been previously used in physiological, but not in therapeutical experiments.

The readiness with which it enters into all the crevices of a wound, the close contact it gives with the parts, and the exactness with which the surface can be limited in treatment, make it a very valuable agent for galvano-caustic operations.

On the other hand, its spontaneous adherence to the skin does away with the use of any artificial adherents; while the slowness in drying, insures the same degree of conductibility and steadiness to the current for a long time. By giving a perfect contact with the epidermis, it prevents any effects from heat, owing to resistance in the passage, and diminishes the pain of the application. Such electrodes might be used with great benefit in other electro-therapeutical applications.—*La Lumiere Electrique.*

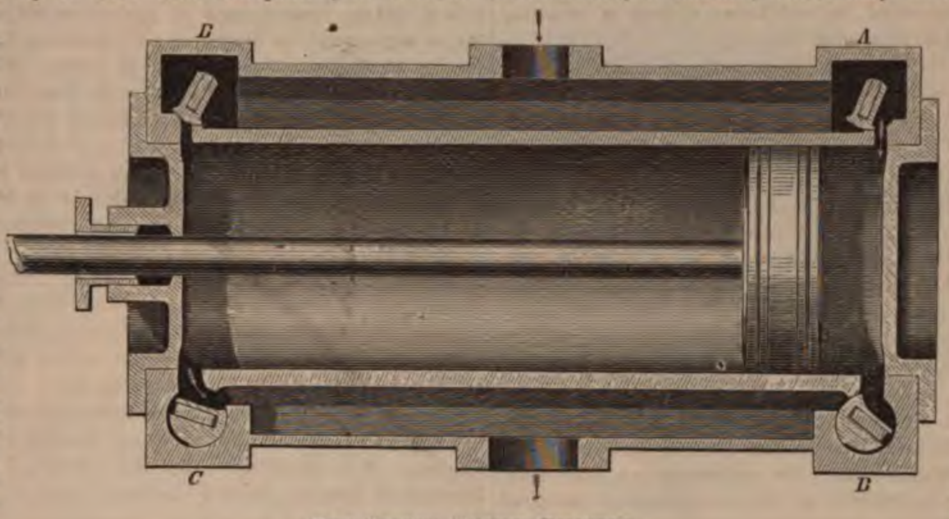
STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

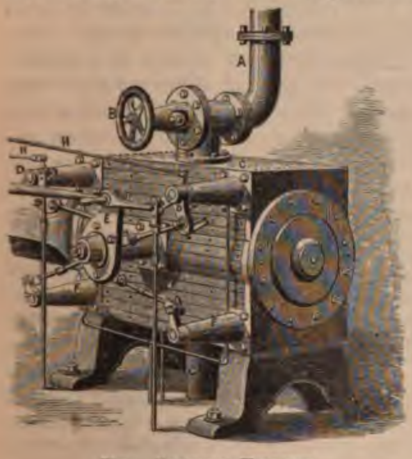
III.—ENGINES INDIRECTLY CONNECTED, ONLY.

THE CORLISS ENGINE (CONTINUED).

FROM what has been stated, it is seen that the Corliss engine came into use in consequence of its combination, to an extent up to that time unequaled, of several special features. Some of these points are not necessarily peculiar to the Corliss type of engine; but they, nevertheless, were peculiar to that engine at the time of its introduction. The main points were: the rapid and wide opening of the steam and exhaust openings; the shortness and directness of the ports; the resulting small clearance and "dead" spaces; the quickness of closure of the steam valves; the adaptation of the main valve to the functions of a cut-off valve; the connection of the governor to the cut-off gear in such a manner as to determine the point of cut-off without being itself hampered by the connection; the location of the exhaust ports at the under side of the cylinder so as to drain the cylinder thoroughly; and the simple, easily constructed form of the machine and of its details.



THE CORLISS ENGINE CYLINDER.

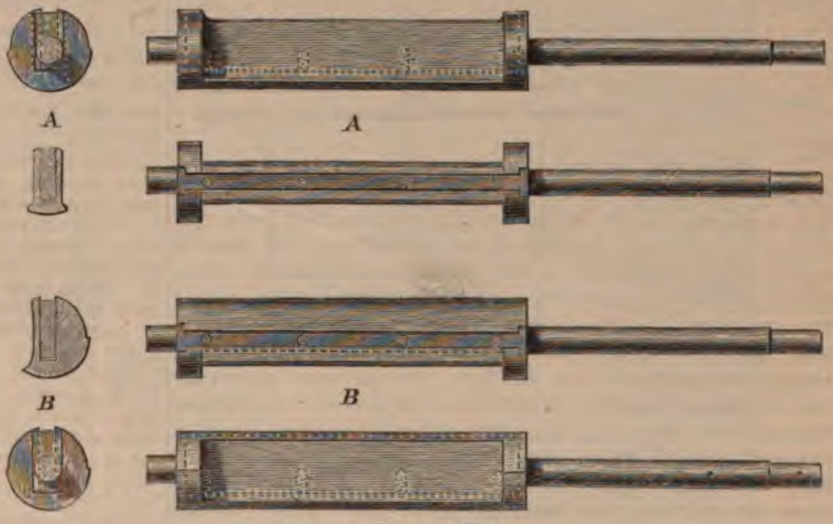


THE CORLISS ENGINE.

The general form of the engine has been preserved by nearly all copyists, and the parts of the valve gear and details of regulating mechanism have been seldom much modified. A few builders have, however, made changes which are worthy of notice, but which we have not time or space to study as they deserve.

The action of the Corliss engine is as follows:*

The valves are driven by the eccentric rod through the "wrist-plate," *E*, vibrating on a pin projecting from the cylinder. Links, *E D*, *E D*, *E F*, *E F*, take motion, from properly set pins on this wrist-plate, to the steam valve rock-shafts, *D*, *D*, and to the exhaust valves, *F*, *F*, moving them with a peculiar varying motion in such a manner as to open and close the ports rapidly, and to hold them open, when the valves are off the ports, in such a way as to give the least possible loss of pressure during the exit or the entrance of steam. The links leading to the steam valves are fitted with catches, or latches, which may be disengaged, as the valve opens, at any desired point within about half stroke; and the time of this disengagement is determined by the rotation of a cam seen on the valve stem above *D*, which cam is rotated by the governor through the rod *H*, leading off to the right. The slowing of the engine, in consequence of reduced steam pressure or of increased load, causes the catch to hold its contact longer and the steam to follow farther, and the reverse. When the catch is disengaged, the valve is closed by a spring or weight attached to the vertical rods seen connected to the rock-shaft arm. Corliss uses a device in place of this which is not here shown. The dash-pots are under the floor, in the case here illustrated, or on the column supporting the governor in the engines just referred to. It is always an air dash-pot. The device invented by Sickles was a water dash-pot.



CORLISS ENGINE VALVES.

The standard form of Corliss valve is very well exhibited by the illustrations here given, which are taken from the drawings of Mr. Harris.

Those marked *A* are the steam, and those marked *B* are the exhaust valves. Both consist, as is seen, of cylinders, parts of which have been cut away, leaving the working and bearing surfaces of no greater extent than is necessary to subserve the purposes of the valve. These surfaces are of the simplest possible form and are easily fitted up in the lathe. In order that they may come to a bearing with certainty, and without regard to the position of the spindle relatively to the valve, they are made with a longitudinal slit into which fits, without jamming, the blade of the rock-shaft. The valves are thus allowed to come to a bearing, and even to wear down in their seats without causing leakage.

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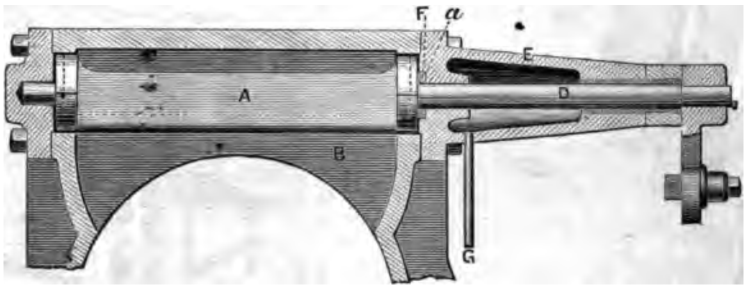
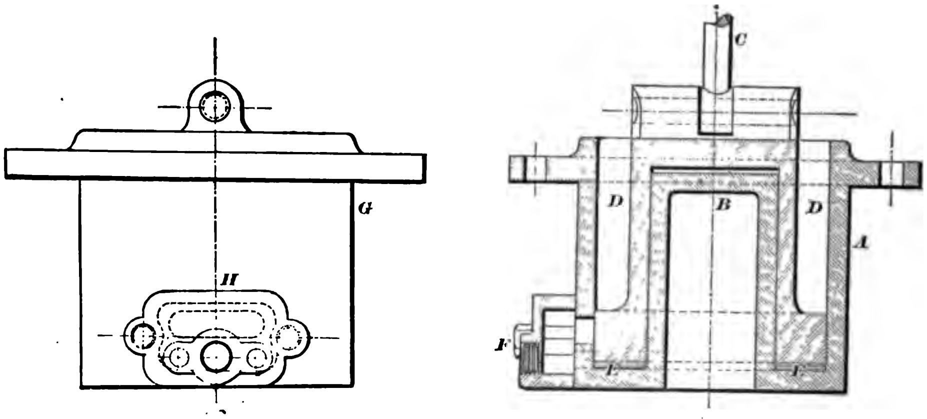
* History of the growth of the Steam Engine. D. Appleton & Co., N. Y. 1878.



Harris-Corliss Valve.

The next Fig. shows the arrangement of this valve as seen in longitudinal section of the chest. As this maker constructs it, the stem goes through a fitted opening, without stuffing box, and the slight drip is carried off from the closed space at *D*; thus none escapes into the engine room. The steel collar at *F*, which is shrunk on the stem, fits into the recess at *a* and serves as a packing. As the tendency of the stem to shift outward always causes the collar to wear to a fit, it is not likely often to wear leaky.

Another detail of interest in the Corliss engine is the "dash-pot." When the valve is suddenly closed, some device is necessary to prevent jar at the instant of its coming to rest. This device is the dash-pot. The form adopted by Corliss consists of a shallow cup into which a piston on the valve stem fits, cushioning the enclosed air, and thus checking the motion of the valve without shock. The dash-pot made by Watts, Campbell & Co., who have successfully introduced Corliss engines into electric light establishments in New York city and elsewhere, is that seen in the Figs.



The Dashpot.

The annular piston, *E*, *E*, fits the cylinder, *D*, *D*, *E*, *E*, and a space, seen above *B*, forms a vacuum chamber which assists the spring or weight, closing the valve by the formation of a more or less complete vacuum, as the piston is raised while the valve is opening. A small cock, not seen, is arranged to adjust the degree of exhaustion of this chamber. When the valve has nearly reached its seat, the piston *D*, passes the opening from *F* into the outer space and the enclosed air then acts as a cushion, checking the movement of the valve. In the engines of these builders, great care is taken to keep the cold exhaust steam clear from the cylinder as it passes out, in order to prevent the condensation which occurs where this precaution is neglected.

Many Corliss engines are already at work driving electric lighting apparatus, and are giving good satisfaction, according to the testimony given the writer by the officers of the companies using them. One, built by the Corliss Steam Engine Co., is at work at Providence, R. I., driving nine dynamos, and a number are in use in New York city, and other large cities of the United States and of Europe.

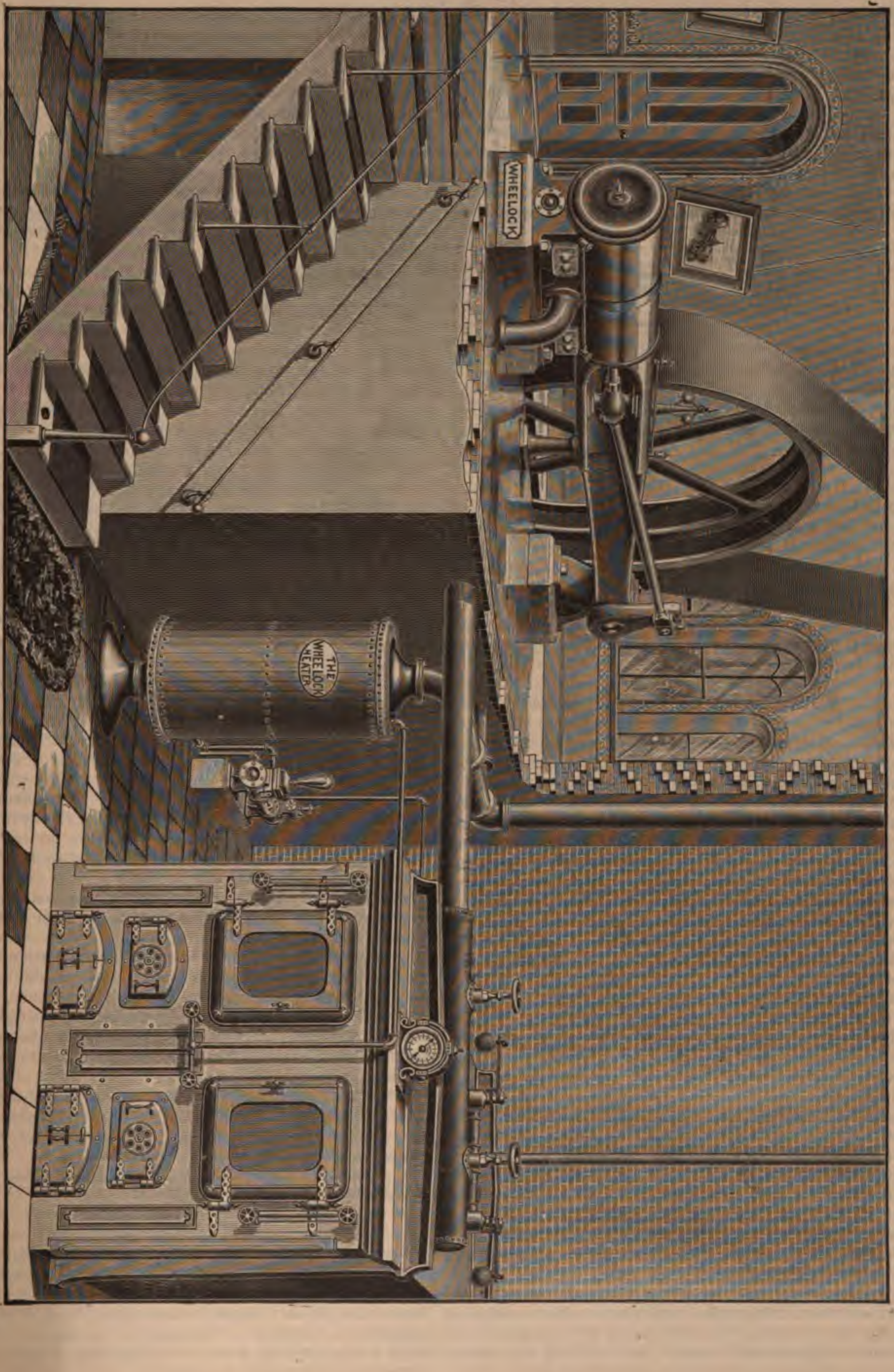
At how high a speed they can be operated with satisfaction to the user is not definitely known. The writer has known one of these engines, coupled to a fast running roll-train, to be driven without apparent difficulty for several years at a speed of 120 revolutions per minute, although of four feet stroke. This engine is still running. Those who use, as well as the engineers who build, this class of engines, however, are apt to be conservative and to prefer the moderate speeds with indefinite endurance, to higher speeds with a shorter life of engine and greater cost in keeping in repair; and to consider that the satisfaction of having a prime motor, which is not likely during their business lives to give them any trouble, is more than a compensation for any possible saving in dollars and cents to be effected by the adoption of the higher velocities of piston and of crank-shaft rotation.

THE WHEELOCK ENGINE

is an ingeniously arranged engine of the class considered in this division of the subject.

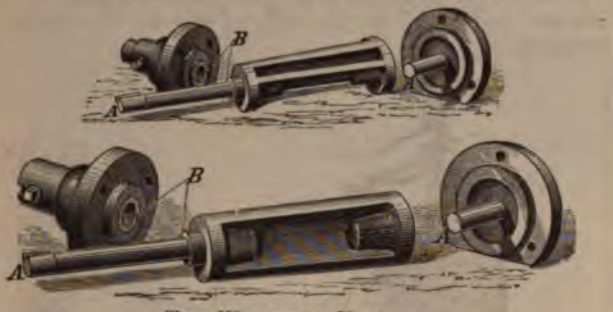
Its form is seen in the accompanying engraving.

The steam chest is placed below the cylinder and the steam and exhaust valves are set side by side, the latter serving both as induction and eduction valve, and having the same action, nearly, as the common three ported slide valve, while the function of the former is principally that of a cut-off valve. The latter, or main valve, is set nearest the end of the cylinder and the exhaust steam is thus permitted to escape directly and promptly from the engine. The valves are coned, slightly, and may be adjusted to take up wear, or to relieve pressure on their seats. These valves are carried on steel trunnions, and with hardened surfaces of contact are but little subject to wear. The steam or cut-off valve is set further away from the cylinder than in the standard arrangements of Corliss and other builders of that class of engines, and this enables the maker of this engine to secure a single port with reduced clearance and less liability to leakage, should the expansion valve leak. In this engine—and it should be the case in every engine in which the regulator is driven by belt—the connection from shaft to governor is so made that the breaking of the belt permits an automatic closing of the valve and the stopping of the engine. The regularity of motion of the class of engines described in this section, may be inferred from the fact stated in regard to the engine here studied, that it has been known to vary but a half revolution per minute when five-sixths of the load was thrown off.



The Wheelock Engine and System.

Engines of the class described in this section have displayed an economy in the use of fuel that has been rarely equaled by the best type of compound engine, working under the same conditions of steam supply. With good boilers, they have given the horse-power with a consumption of two pounds an hour for condensing engines, and three pounds for non-condensing engines. They have very commonly demanded but a ton of coal for 100 barrels of flour ground, in well arranged mills; and one and a quarter tons is a very usual figure. A number of good makers are now building such engines, and the purchaser can readily suit himself if desirous of selecting an engine of any grade, either as to cost or excellence of construction. They are well adapted to driving either large or small electric lighting plants; and, if purchased of a reliable maker, may be confidently expected to give satisfaction.



THE WHEELOCK VALVES.

FORMULAIRE PRATIQUE DE L'ELECTRICIEN

PAR E. HOSPITALIER: PARIS. G. MASSON.

THIS work comes at a very opportune time. Its valuable information is required at every moment by the practical electrician, while the high scientific attainments of the author give the work that authority that is so essential in these days of "book-making." As is well-known, the science of electricity is developing such astounding possibilities, and is so susceptible of all the efforts of patience and the discoveries of inventive skill, that the electrician of the present, not to speak of the future, must be a professional who follows closely electric progress. To obtain all the useful information can only be done by closely studying such publications where the results of this progress have been brought to a focus.

The first part of this work gives definitions and general laws, and constitutes a little treatise in itself. To units of measure some 25 pages are devoted. The third part, comprising 70 pages, is on "apparatus and methods of measurement." It is copiously illustrated, and all the *formulae* given.

The remaining 150 pages are given up to "practical information of all kinds," bearing on electricity, logarithms, geometric formulas, density of metals; very useful tables, showing the value of Fahrenheit and Centigrade scales, fusion point of minerals, their resistance and conductibility, etc., as well as necessary *data* with regard to chemicals and liquids. The telegraph, the telephone, electric lighting, the best method of soldering and repairing, and a mass of scientific facts, are all given the space required by their importance. Finally, a long list of the works consulted, forms a sort of electric bibliography, and shows what condensed knowledge the possessor of the volume is presented with. The work is very tastefully bound, well printed, the matter compact, the volume itself convenient to handle.

THE APPROACHING CINCINNATI INDUSTRIAL EXPOSITION.

IN view of its success in previous seasons, the announcement of the Eleventh Annual Cincinnati Industrial Exposition, to open on Wednesday, Sept. 5th, and close on Saturday, October 6th, 1883, is, in some degree, of national interest.

The circular of rules, and the premium list, received, is especially interesting to manufacturers of electrical appliances, since it offers premiums for a miscellaneous assortment of electrical devices.

Various electrical apparatus are admitted for competition, as, for instance, in Class 71, among medical and surgical appliances, "galvano cautery batteries" are included. But the most important feature of the coming exhibition is indicated by the issue of a special circular relating to No. 1382 of Class 72, system of electric lighting. By this circular, we are informed that it is proposed to have expert tests of all the various electric lighting systems, and that all the prominent companies of the country have signified their intention to compete. It is expected that this test will be thorough, and, being one of the first of its kind ever made in this country, the result will be anticipated with great interest. It is stated that a jury of the best experts in the country has been secured. We subjoin the

EXTRACTS FROM THE RULES AND REGULATIONS.

The Eleventh Grand Exposition will be open for the reception of articles, from Wednesday, August 15th, to Tuesday evening, September 4th, 1833.

Articles competing for premiums, must be receipted for by the Secretary, and the entry tags attached, on or before September 5th.

No charge will be made for space or power, but each exhibitor (except amateurs, and exhibitors in the fine arts, and natural history departments) will be required to pay an entry fee of two dollars. An exhibitor, competing for more than one premium (except in the horticultural department), shall pay two dollars for each additional premium competed for.

Articles for competition must be of American manufacture, and entered by the manufacturer, or his agent, excepting those otherwise stated in the premium list.

All premiums awarded will be for first degree of merit only (except in the horticultural and tobacco departments).

Applications for space may be made at any time, and should be made as early as possible, and at least three weeks prior to the opening of the Exposition.

Exhibitors are requested to enter their articles with the entry clerk, and procure their class tickets with the least possible delay, but not until the articles are received into the building.

Exhibitors shall circulate no advertisements, except as to their own business, and from their own space, except by the permission of the board. Exhibitors violating any rule of the board shall have their license to exhibit revoked.

The driving engines will be in operation one week previous to the opening of the Exposition. All machinery must be in running order and all goods in position, ready for exhibition, on Wednesday September 5th.

N. B.—For further information, see the general rules and regulations which will be furnished on application.

— THE *Brazilian Times*, May 9th, reports that Messrs. C. P Mackie, J. J. Palhares, and J. F. de Lacerda, have registered the statutes of the Companhia Nacional de Electricidade, with seat in Rio, to construct, work, sell, etc., telegraphic and telephonic lines, or other works or application of electricity or magnetism, in the empire. The capital, which is fixed, primarily, at $100,000, in $200 shares, with power to raise to $1,000,000, was at once subscribed.

THE A, B, C, OF ELECTRICITY.

LIEUT. BRADLEY A. FISKE, U. S. N.

PART II.

Reis's musical telephone consisted of an apparatus in which a diaphragm, which could be vibrated by the voice or other means, took the place of the vibrating reed; the great superiority of the diaphragm over the reed lying in the fact that, while a reed can vibrate to a tone of only one pitch, a membrane secured at all points around its circumference, will vibrate to any and all sounds; vibrating rapidly to sounds of high pitch, and more slowly to sounds of lower pitch, vibrating violently to loud sounds, and more gently to feebler sounds.

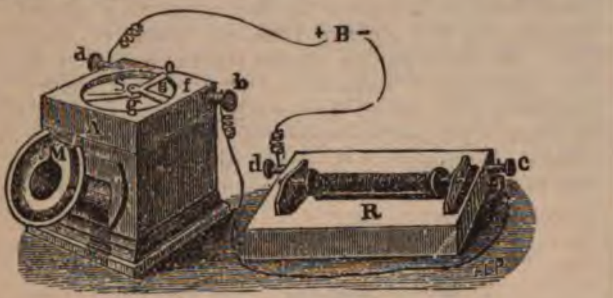


FIG. 2.

The apparatus, as constructed, is shown in Fig. 2.

When a person sang into the mouth-piece shown, the membrane on top began to vibrate, and in so doing caused a light metal arm which rested upon it to hop up and down. This metal arm was connected to one pole of a battery, and a piece of platinum upon which it rested (the piece of platinum being glued to the diaphragm) was connected to the other pole. When this little metal arm then jumped up, it would leave the platinum piece, and when it descended, it would fall upon it; thus breaking the circuit in the first case, and re-establishing it in the second.

Therefore, as each note was sung, the current was broken, a number of times depending upon that note. The wires of the circuit went to the receiver, which consisted of merely an electro-magnet mounted on a hollow sounding-box. Now, it was discovered by Professor Henry, that when an iron bar is magnetized, it becomes slightly elongated; and that when it is demagnetized, it returns to its usual length. When, therefore, Reis sent his rapidly recurring currents through this electro-magnet, the bar was subjected to a very rapid succession of elongations and shortenings, or longitudinal vibrations. These longitudinal vibrations caused the emission of notes depending upon the number of vibrations, so that the receiver gave out just the same notes as were sung into the mouth-piece. The sounds were very feeble, however, and the instrument never was made of any practical use.

When Bell turned his attention towards the invention of an instrument for electrically transmitting speech, it was evident to him that some means had to be devised more delicate than any then known. Understanding, as he did, the complex nature of the tones of the human voice, he saw that no instrument like that of Reis, which made and broke the circuit, could ever accomplish the desired result. He recognized the fact that in such an instrument, the current is established abruptly in full strength when the circuit is made, that it ceases abruptly when the circuit is broken, and that it remains at an unvarying strength during the interval. Characterizing such a current as intermittent, or pulsatory, he saw that the only suitable current would be one to which he gave the name *undulatory*—meaning one which gradually rose and gradually fell, rising high during the utterance of strong tones, and low during the utterance of weak tones. In order to understand the manner in which he accomplished the production of this undulatory current, it will be necessary to remember how Faraday discovered that if he approached a magnet towards a coil of wire whose ends were connected together, a current of electricity was produced in that wire which lasted as long as the motion lasted, and that when he removed the magnet, a current was produced in the opposite direction. These currents were said to be "induced" in the coils of wire by the motion of the magnet.

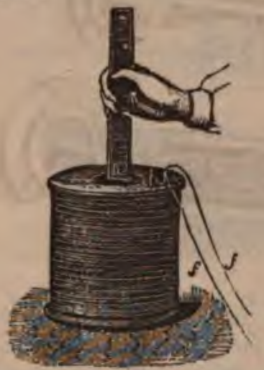


FIG. 3.

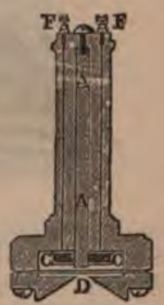


FIG. 4.

Passing over Bell's first crude apparatus, it will suffice to describe the form his telephone finally assumed.

A represents a steel magnet surrounded at one pole by the coil of fine wire *C*, which is connected to the two screws *F*, to which are secured the wires of the circuit. Opposite to this coil is an iron diaphragm *D*, which is magnetized by the steel magnet *A*, and is, therefore, temporarily a magnet. Now, when a person speaks against this diaphragm, he sets it vibrating. As has been said above, a diaphragm, supported all around its circumference, will vibrate to all tones. It will vibrate fast under the influence of high tones, and more slowly under the influence of low tones. It will vibrate to a considerable distance on each side of its usual position under the influence of loud tones, and to a less extent under the influence of more feeble ones, just as a swing will move to a considerable distance from the vertical under the influence of a powerful thrust, and to a less distance under the influence of a weak one. Being a magnet, the disc will induce a certain current in the coils when moving towards it, and in the reverse direction when receding. It will induce a strong current when a loud tone sends it forward with violence, and a weaker one when a weaker tone moves it more gently. Thus we see that it induces in the coils "undulating," or gradually rising and falling currents. At the receiving end, the only thing necessary is an apparatus for converting these undulating currents of electricity into undulating waves of sound. To do this a "receiver" is used, exactly like the instrument just described. The current, on entering the coils *C*, causes the attraction of the metallic diaphragm *d*, which here acts as an armature. It is attracted strongly when a strong current passes, and feebly when a weak current passes. Thus the diaphragm *c*, in the receiver, vibrates exactly like the diaphragm in the transmitter. But, in vibrating in the same manner, it must give out the same sounds as were received by the transmitter. Thus we see that in telephoning, we do not send the voice from one place to another; we merely convert the energy of the voice at the sending end into electrical energy, and convert this electrical energy back into sound at the receiving end.

A curious modification of the telephone is found in the microphone, an instrument so sensitive that it not only transmits sounds inaudible to the unaided ear, but also magnifies them in the most startling way. The ticking of the watch shown in the diagram, will sound to a person listening at the receiver *R* like the blows of a hammer; while the scratching of a pin along the surface on which the watch rests will be rendered by a discordant shriek.

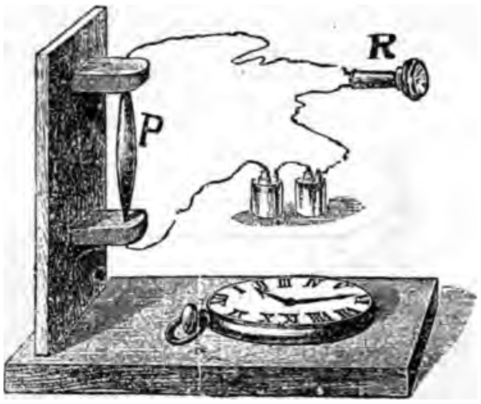


FIG. 5.

The theory of this remarkable instrument is a matter of incessant dispute among electricians, though all agree that its action is due in some way to disturbances set up about the contacts at the ends of the carbon pencil *P*, by the vibrations of the watch or other disturbing element. It is supposed that these vibrations are communicated to the frame holding the supports in which the carbon pencil rests, so that its ends are shaken in their resting places. Many of the transmitters used are modifications of the microphone, in which the voice takes the place of the watch shown in the diagram. These telephones, however, and in fact all telephones, operate on the principle of the "undulatory current," and therefore are covered by Bell's broad patent, which claims the use of an undulatory current for electrically transmitting speech. Bell's is probably the most valuable single patent ever granted.

For generating the immense quantities of electricity necessary for electric lighting, it has been found that the method of using zinc and copper in chemical solutions is too expensive. It is for this reason that electric lighting did not come into use in the early part of this century; for inventors even in those days, made good electric lights both for out-door and in-door use. It was not until Faraday, in 1831, discovered the possibility of generating electricity by the mechanical means of moving magnets in proximity to coils of wire, that electric lighting became practicable; and it has not been until within the past few years, that the improvements in the ways of applying this discovery have been such as to make it sufficiently economical. It can be said without error, then, that the recent great advance in electric lighting has been more because of improvements in the way of generating the current economically, than in the ways of using the currents in lamps. It need not be said that numberless improvements have taken place in lamps as well, but these followed as a matter of course.

It will be remembered that Faraday discovered that the approach of a magnet pole to a closed circuit of wire, occasioned a current in one direction, and its recession a current in the other direction. As no current existed when motion ceased, it was clear that the producer of the current was not the magnet but the mechanical motion, or rather, the mechanical energy of the motion; and that the magnet acted merely as the vehicle by which the mechanical energy could be converted into electrical energy. The practical bearings of this discovery were so obvious, that inventors began immediately to devise means for conveniently producing the motion of large magnets near large coils of wire, or what served the same purpose, the motion of coils of wire in the vicinity of magnets. Inventors are still at work upon this problem, for it is not fully solved as yet. Sufficiently good results, however, have already been achieved, to render the production of enormous currents by this means a practicable and even economical matter.

One of the earliest machines for generating electrical currents by combining mechanical and magnetic forces is that shown in the diagram. The horse-shoe represents a large steel magnet, whose two poles are marked N and S. In front of these poles are two coils of wire mounted upon an axis in such a way that they can be revolved by the handle A, and thus approach and recede from each pole in succession. Therefore, as was shown above, each coil has induced in it a current in one direction, when leaving one pole and approaching the next; and in a contrary direction, when leaving this pole, and approaching the first. Now if we join the two coils by a wire outside the machine, a current will traverse the wire. In all the machines of the present day, no matter how elaborate, the same general principles are utilized; but the coils are now revolved by steam power. All of the different machines, however, may be divided into two classes, according to the shape given to the revolving coils which are called armatures; in the first class the coils are wound lengthwise around a cylinder or drum; in the second they are wound around a ring; and in nearly all large electrical machines the large steel magnets formerly used, have been replaced by electro-magnets, or masses of iron which are magnetized by passing around them an electric current. In most machines, the current generated by the machine is that used to magnetize the magnets.

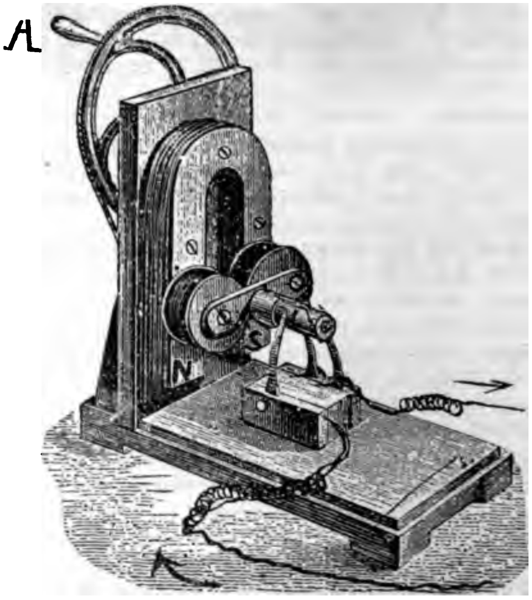


FIG. 6.

The usual name given to electric machines, in which the current generated is used to magnetize the magnets, is "dynamo machine" or simply "dynamo."

(To be continued.)

—— SUITS IN THE U. S. Circuit Court have been recently instituted by the Consolidated Electric Light Co., against the Edison Electric Light Co., for infringement of patents granted William E. Sawyer and Albon Man, for a system of electric lighting.

A PLEA FOR THE GAS ENGINE.

To the Editor of the Electrician:

THE letter published in your June number in relation to the efficiency of steam engines, together with the editorial, in the number for April, on the prospects of electric lighting, brought to my mind the references made by Dr. Siemens in his presidential address before the last meeting of the British Association, to the use of the gas engine. Your correspondent calculates the efficiency of the steam engine as being the ratio of the work it performs from a given amount of heat to that which a perfect engine would perform from the same amount, but while this is a good test of the efficiency of one class of engine, it renders comparison between different classes of steam and gas engines very difficult. Of two perfect engines, that is most efficient practically which is capable of *receiving* the greatest amount of heat, or of working between the greatest limits of temperature. In comparing dissimilar engines, therefore, it is necessary to compute their efficiency on the absolute scale.

Dr. Siemens illustrated his point by supposing a gas engine to have in its cylinder a temperature of 1500°c., and to exhaust into the atmosphere at a temperature of 600°c. The efficiency of a *perfect gas engine* would be $\frac{900}{1774}$ or 50.7 per cent. He further assumed the range in a good steam engine to be between 150°c. and 30°c., giving as the efficiency of the *perfect steam engine* $\frac{120}{424}$ or 28.2 per cent. The loss in a gas engine is fully one-half from friction, and particularly from the necessity of carrying off the heat absorbed by the cylinder. Allowing this, the gas engine would utilize .253 of the energy furnished it. Assuming, with your correspondent, that the best steam engine gives eighty per cent. of the work of a perfect engine, it utilizes .223 of the heat supplied.

This calculation shows but a slight advantage for the gas engine, but it is a comparison between a comparatively new crude machine, and another the *best* that inventive genius has been able to perfect in nearly a century of improvement. The steam engine is heavily handicapped by the small range of temperature within which it works, and this disadvantage appears to be inherent. The gas engine, however, not only possesses a much greater range but this may apparently be still further increased. Dr. Siemens confidently predicted the supplanting of steam by gas in the near future.

The defects of the gas engine are well-known, but progress is almost always slow, and recollecting what invention has done towards perfecting the steam engine, he would be rash indeed who asserted that it had exhausted its genius on the theoretically better gas engine. Even now it is said, by Silvanus Thompson, to be possible to obtain with a 16 H. P. gas engine, one indicated horse-power from seventeen cubic feet of gas, which could easily be obtained from 3.8 pounds of coal. But few steam engines of equal power give as economical results. Even better results may be obtained by using gas, not made for illumination, but for the special purpose of working machinery. Two improvements are possible; one to make a gas which would contain a greater proportion of the intrinsic energy of the coal; the other to utilize waste products such as coal dust which are now worthless, and thus secure economy.

In the London *Electrician* of June 2, Mr. F. W. Crossley, a large manufacturer of gas engines, says, that with Dowson gas he can obtain "one indicated horse-power for $\frac{1}{15}$ of a penny per hour, or counting anthracite at 10*s.* per ton, say $1\frac{1}{2}$ pounds of coal." Engines have been worked indicating 60 H. P., and he asserts his belief that they can be made to yield 500 H. P. by using several cylinders, thus correcting also the great objection of irregularity of motion.

The Dowson gas referred to, is made by passing a jet of steam into an anthracite fire. The approximate composition is by volume.

H	20	This gives by weight.	H	.024
CO	30		CO	.503
CO_2	3		CO_2	.079
N	47		N	.394
	100			1.000

The energy of the gas is only about one-fifth of a corresponding volume of coal gas, but it is so cheaply made that the cost of the same amount of energy is less. In the light of figures of this kind it seems as though the economical production of electricity had a very close connection with the development of the gas engine.

J. B. MURDOCK.

ANNAPOLIS, Md., June 13, 1883.

THE "TÖPLER-HOLTZ" INFLUENCE-MACHINE.

CHICAGO, June 16, 1883.

To the Editor of the Electrician.

IN order to settle the question of the origin of the electric machine, known as the "Töpler," or "Töpler-Holtz," I wrote to Prof. Töpler, and also to Dr. Holtz, to know whether the Töpler machine was an original, independent invention, or a modification of the Holtz machine.

Prof. Töpler has not yet been heard from, but the following clear, concise reply from Dr. Holtz is very satisfactory. Respectfully,

P. ATKINSON,
168 Randolph Street.

GREIFSWALD, Germany, March 20, 1883.

Mr. P. Atkinson:

Much Esteemed Sir—Your valued letter has reached me by a very circuitous route, on which account I could not reply till to-day.

If Poggendorff's Annals of Physics and Chemistry are at your command, I would request you to turn to volume 125, page 469, and volume 126, page 157, Summer of 1865, and you will then be able to answer best yourself the question you proposed to me.

In case the above work is not accessible to you, permit me to reply in brief as follows:

The machine in question has this property, that one and the same movable disc delivers both electricities at the same time. An influence-machine which is so constituted, *I* must, of course, denote as *my* invention. The Töpler machine, invented at the same time, was a combination of two pairs of discs in such a manner that each of the two movable discs gave only the one electricity.

Töpler has recently rejected his system and adopted mine, because it is simpler, and, at the same time, more effective. The application of the pointed combs and the non-covered movable discs is also *my* invention, since the Töpler machine had only the tinfoil coverings and sliding springs. (*Schleifende Federn.*)

I had been accustomed to the same, indeed, already; although not with independent acting, influence-machines,* but rejected them on account of the smaller spark-length.

Töpler has also lately adopted my principle of the pointed combs, and the non-covered discs; but so far modified, that *besides* the pointed combs and non-covered discs, he yet allows to act, at the same time, small pieces of tinfoil (or pieces of metal), and the sliding springs. This has the advantage that the machine excites itself, and is less sensitive to moisture; but also the great disadvantage, that the sparks become shorter, and a constant reversal of current follows. Besides, a certain mechanic, Voss, also claims this machine, so modified, as his merit; but unquestionably

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* Reports of the Berlin Academy of Sciences for April, 1865.

Töpler was the first who showed that influence-machines, with metallic covering and sliding springs excite themselves.

The entire form of the machine, its symmetrical construction, the one-sided support of the axis, the application of a sheath running upon a pin fastened on one side, the application of the so-called rotary diametrical (double) pointed combs, the application of the so-called condensers (small Leyden jars) for increase of spark-length, the application of the insertion apparatus in imitation of inductive action, is all mine, as published in the year 1869, by Prof. Poggendorff (Poggendorff's *Annalen*, vol. 136, page 171).

Yours truly,

DR. W. HOLTZ,

P. S.—My latest publication on influence-machines you will find in Poggendorff's *Annalen*, supplementary vols. 7 and 8; Wiedemann's *Annalen*, vol. 13; Giebel's *Journal for the Collected Natural Sciences*, vol. 53; *Communications of the Natural Science Association for Neuvorpomern and Rügen* (located in Greifswald) years 1877 and 1879; *Journal for Experimental Teaching of Electricity*, by Uppenborn, year 1881 (Hannover-München); Carl's *Reportorium of Physics*, year 1881 (München).

My first publication of the self-constant acting influence-machines, you will find in Poggend. *Ann.*, vol. 126 (already referred to), vol. 127, page 320; vol. 130, pages 128 and 168; namely, the machine with two discs rotating in opposite directions, without stationary discs. Poggend. *Ann.*, vol. 130, page 387, "Various Machines;" vol. 136, page 171, "The two principal Machines in Improved Form."

MIXING OF TELEPHONE SIGNALS.

To the Editors of The Electrician:

GENTLEMEN—In your issue of June, there appeared an article by Mr. M. G. Essig, taken from the *Journal Telegraphique de Berne*, upon the "mingling" of telephonic signals. In speaking of the "mingling of signals" [by which, we suppose, Mr. Essig undoubtedly means, what is called in the United States "induction," or the currents of electricity upon one wire, producing similar currents upon a neighboring wire.] He says: This mingling must be attributed, more to the way in which the central bureau is fitted up, than to the conducting wires.

To illustrate this theory, a description of the German central office system is first given, (which, by the way, is essentially the same as that used throughout the United States) and then proceeds by stating that this "mingling of signals" is caused by the presence of the electro-magnets of the annunciators, telephones, and magneto transmitters of Siemens (used in the German system) acting upon each other, by magneto-electric induction, or by the reciprocal action of "tongued electro-magnets." Mr. Essig does not state by what means he was induced to arrive at such a conclusion, but one would be inclined to believe, they were purely theoretical, and were not based upon experimental data.

As we all know, every switch board, both here and in Europe, has, in connection with it, electro-magnets, in which the subscribers' connecting lines terminate, and which are placed closed together in groups of from 5 to 50. It is in these groups, that Mr. Essig believes the trouble to be generated.

Now, in the first place, the power of an annunciator electro-magnet, with a thick bar armature, or a "tongued electro-magnet"—such as is used in the construction of telephone switch boards—to transmit articulate speech is very feeble, even when words are spoken directly to it in a very loud voice, and then can only be detected by an experienced ear; therefore, how much less is the effect produced by the induction of an adjacent electro-magnet. But in order that we may be the more certain of our statements, let us examine, experimentally, a "central bureau" of one hundred and forty subscribers. In the first place, we will connect the coils of an annunciator magnet with a Bell telephone, and then request some subscriber to talk through the coils of an adjacent one. We shall not be able to detect the slightest sound. Secondly, let a Bell telephone be held in such a way that its longitudinal axis is parallel to, or in line with, the cores of an annunciator, through which a subscriber is talking. The sound produced will be so feeble that it is only with great difficulty that it can be heard at all. Thirdly, place a Bell telephone parallel, or in line with a second Bell telephone, through which words are being spoken; the result will be the same as the last above mentioned experiment.

If a coil of very high resistance be connected to a telephone, and then applied to the various electro-magnets of a switch board, words can be faintly heard. Next, let us examine the connecting wires of the exchange, that are confined to the central office construction; such as cable wires, and all others used in joining the outside line wires, with the operating room; this to be done by listening upon one wire, while a person speaks over a neighboring one. We shall find that words can be distinctly, but faintly, heard; not loud enough, however, to disturb a conversation being carried on over the wire upon which we are listening. And now let us test the entire connecting system of wires, both inside and out of the central office. In the first place, we will take two wires, leaving the cupola or roof fixture in opposite directions. We will request a subscriber to talk to us over one going East, while we listen on the wire running West. Words will be heard faintly, just as in the case of the office wires. Secondly, let us test, in the same way, wires running parallel for three sections, after leaving the cupola, then diverging. In this case, words will be more distinctly heard than before. Thirdly, take two wires, running for one-half mile upon the same poles. We shall now find that it is possible to carry on a conversation, by the induction between the two wires, it still being possible, however, to distinguish easily between a conversation carried on in this way, and one where both telephones are joined to the same wire. But take a case where two wires run parallel upon the same poles, for fifteen miles, or even six, and we shall find it perfectly easy to talk from one wire to the other, and at times it will be difficult to tell whether the person with whom we are talking, is speaking over the wire we are listening upon, or a neighboring one. In other words, the smaller the angle formed by the two wires, in question, the greater the induction produced.

Although these facts are doubtless very familiar to you, and are simple illustrations of the well-known laws of electro-static and dynamic induction, yet it seems as if Mr. Essig must have forgotten them, when he lays so much stress upon the mixing of signals being due to central bureau construction. As we have seen, electro-magnetic induction does occur between the various wires and magnets of a central bureau. In fact, the whole operating room may be considered as one immense transmitter. Yet it is evident, however, that the central bureau, with all its wires and magnets, produces so small a proportion of the trouble ("mingling of signals" or induction), as compared with hundreds of miles of parallel wires, comprising the connecting system of pole-lines of every large exchange (so subject to leakage, induced currents from neighboring wires, the atmosphere, and the earth), that it may be entirely neglected in our calculations; for were all the induction removed from central office instruments, it would not produce an appreciable change in the total amount.

It must be remembered that the electro-magnetic field of a wire through which a current of electricity is passing, is very large, and for practical purposes, may be considered as a cylindrical area, with the wire as a centre, extending along its entire length, and having a diameter greater than seventy feet. (This diameter is merely mentioned as it is useless to bring wires nearer than this, and expect to avoid the mingling of signals, unless a large number of wires are to be used, when a certain amount of neutralization takes place.) Again, it is needless to remind Mr. Essig, of the vast number of experiments and inventions that have been tried during the past four years; all the best of which have been made upon the principle of neutralizing the induced currents upon the *long line wires*, nor is it necessary to mention the fact that the mixing of signals can be avoided by using metallic circuits in connecting the subscribers with the central bureau. Had Mr. Essig held to his original opinion in regard to the seat of this trouble, as expressed in his first paper, he would have come nearer to what would seem to be the truth, and had he based his last paper upon experiments conducted at a number of different exchanges, it would have given his remarks greater weight. But in the United States the number of experiments performed with the idea of overcoming induction, has been so very large, that we cannot yield before the facts resulting from a single instance in Germany, where the number of telephones in use is so insignificant as compared with the United States.

I remain, gentlemen,
Your obedient servant,
W. R. CABOT.

YONKERS, N. Y., June 18th, 1883.

ELECTRIC LARNYGOSCOPE.

To the Editors of the Electrician:

GENTLEMEN—It may be interesting to some of your readers to hear the results of some experiments with electricity in the diagnosis and treatment of diseases of the throat and nose, which I have made for some years past, especially as I notice in the June number of your journal an article on "Hêlot and Trouvé's frontal electric photophore." The advantages offered by the electric light over any other artificial source of light, for illuminating the cavities of the throat and nose, became apparent to me as soon as the incandescent system was introduced, and following up the idea, I constructed a number of different devices with the material at hand, viz: a bi-chromate battery of my own construction, and a Swan lamp which I obtained from a friend, after having in vain applied to the manufacturers for a supply.

The battery which I used consists of twenty pairs of carbon and zinc plates, mounted on a platform in such a manner, that, by a commutator, they can be combined for quantity or for intensity. These plates hang from the platform over the rubber cups containing the exciting fluid, which latter are placed upon a movable platform, and can be raised by a treadle to any height desired. Thus the current can be regulated by the immersion of the plates. The fluid used is made by adding sulphuric acid to a saturated solution of crude chromic acid, in the proportion of 1—7, and has an advantage over the bi-chromate of potash fluid, inasmuch as no crystals of chrom-alum are formed. This battery I have used for several years for heating the platinum loop, when performing operations with the galvano cautery, in the cavities of the nose and throat, with great satisfaction, as it is always ready, and I need no assistant to work the battery.

Last fall I obtained a Swan lamp, and connecting it with my battery, obtained a very good light, which I at once endeavored to use for laryngoscopy. After a number of trials, I found that the best results were obtained by mounting the lamp in front and a little to one side of the ordinary head reflector, and mounting the latter upon the head, a light was obtained which was superior to gas or lamp light, both in brilliancy and whiteness. Another very great advantage over the ordinary manner of reflecting the light from a stationary lamp was, that after the reflector had once been adjusted, by means of its universal joint, the light was always thrown in the line of vision, thus taking away the strain from the neck, which becomes very tiresome, especially to the beginner, when a stationary light is reflected into the throat. Of course, everyone who works with gaslight, in an artificially darkened room for six or eight hours a day, will at once appreciate the difference between an argand burner and an incandescent lamp, as regards heat and purity of the atmosphere, and therefore will say no more about it.

A short time ago I obtained a small two-candle incandescent lamp which, when mounted on a long stem, could be introduced into the mouth, and thus the cavity of the throat could be illuminated directly. Theoretically, this seemed very advantageous, but practically, it would not work, for the lamp was too bulky, and developed too much heat to be borne by the patient, and the rays falling directly into the observer's eye, interfered materially with the definition of the image.

A short account of these experiments I inserted in the second edition of my book on "Diseases of the Throat," which was published several months ago, and was either out or in press, I forget which, on April the 16th, when Trouvé and Hêlot made their communication to the academy of France.

Very truly yours,
CARL SEILER, M. D.,
Lecturer on Diseases of the Throat, at the University of Pennsylvania.

PHILADELPHIA, June 15, 1883.

—— THE *Tribune*, June 15, reports that the long discussion by the Governing Committee of the Stock Exchange, at its meeting on Wednesday, in regard to the relations of the Gold and Stock Telegraph Company with the Exchange, was provoked by a threatening letter from the telegraph company. If a rival company was to be admitted to the floor, the letter stated that the Gold and Stock Company would remove its telegraph instruments, and begin suits against the Exchange. The contract made with the Gold and Stock Company expired about two years ago, and has never been formally renewed. It has been allowed to continue in force indefinitely, by the tacit consent of both parties to it. The receipt of a letter threatening legal proceedings against the Exchange, excited a great deal of indignation among the governors, and the discussion became long and heated. The result was the adoption of a resolution, directing the secretary to send notice to the Gold and Stock Telegraph Company, that the contract would be terminated at the end of the month, and that the terms on which the company would be allowed to occupy the Exchange after that time, would be a matter of agreement from month to month.

—— THE SUPERINTENDENT of a large saw mill establishment, in Scott County, this State, wants to know why it was that he couldn't braze a band saw, one day, recently, while a thunderstorm was in progress. He states that he tried, repeatedly during the day, to join the two ends of the saw, but without success; and, inasmuch as the atmosphere was electrically disturbed, he suggests that probably electricity had something to do with his failure. The day following the storm, he adds, was fair, and his first attempt at brazing on that day was a perfect success. Anyone who has a theory to project in answer to this inquiry, will find room in these columns, for, as to ourselves, "we give it up." And in order to clear the way for theorizing, we will explain the method which is ordinarily followed in brazing band saws: After the two ends of the blade have been scarfed with a file and cleaned in an ordinary way, the surfaces are washed in muriatic acid (sometimes powdered borax is used instead of the acid), and when the ends are brought together for joining, a slip of prepared silver solder is introduced between them, large enough to cover the surfaces. A pair of tongs, the jaws of which have been heated previously to a full red heat, are then used to hold the ends together till the solder begins to run. The cooling is then effected with water and a sponge.—*Age of Steel*, St. Louis, Mo.

OUR PARIS CORRESPONDENCE.

PARIS, June 10, 1883.

WHEN M. Marcel Deprez lately experimented at the station of the Chemin de fer du Nord, with the electrical transmission of power, we pointed out the many shortcomings in the system, and we expressed a fear that the results would not fulfill the hopes of the inventor. Despite the eulogiums which the Academy of Sciences have bestowed on the author of the remarkable researches of the theory of electrical machines, it must be admitted that our views were completely justified, from an industrial point of view—we need adduce no other proof than the lecture on electric transmission of power by M. Tresca, who was one of the members of the committee on the experiments of M. Deprez.

M. Tresca takes care to inform us that he speaks as an engineer and machinist, and not as an electrician—the precaution was hardly necessary, for when he comes to speak of electric unities we are soon convinced that he is but little acquainted with their use. He proposed to compare the various known methods for the transmission of power, and especially that of electricity. He does not seem to us, however, to have exactly appreciated the special *rôle*, and the advantages presented by electricity.

The methods of transmitting power by telodynamic cables and compressed air have their well-defined applications; when the distance in the open air is not more than a few hundred yards, the cables are both convenient and offers certain advantages. Compressed air is excellently adapted for working drills in tunnels and mines—the utilization of the Rhone at Bellegarde may be cited as an instance of the former, and the cutting of the Mont Cenis and Gothard tunnels, of the latter. There are, however, special conditions and solutions in these cases that are easily understood, but which do not warrant us in making any universal application of them. Besides, distance is only of secondary importance here, while it is just the very possibility of traversing long distances that gives all the value and importance to the use of electricity. The comparison made by M. Tresca between the various methods does not seem to us to be correct, and it is altogether misleading when an attempt is made to prove the economic superiority of such, or such a system; the return given by a telodynamic transmission of 900 yards cannot be compared with that of an electric transmission at 8,000 yards. We were naturally led to this reflection on being informed that a return of 90 per cent. is obtained at Bellegarde, and that compressed air also gave 90 per cent. These figures give room for discussion and display a certain pre-judgment against electricity.

M. Tresca acknowledges, however, that great progress has been made in the electric transmission and distribution of power. He repeated the experiments made by M. H. Fontaine, at the Vienna Exposition of 1873, with two Gramme machines, separated by a copper conductor of 1,000 metres, and then spoke of the types at present being constructed in the shops of the Compagnie Electrique, which can transmit from 0.5 to 16 horse-power with an electromotive power of 1,000 volts, and a velocity of 1,000 revolutions per minute, to a distance of 2,000 metres. And no experimental apparatus is here in question, but regular working machines now used in mines and workshops, etc. The return under these conditions is in the neighborhood of 50 per cent., when carefully measured. The results that have been obtained during actual work for several years are, therefore, in complete contradiction to some of the statements of M. Tresca, who confines himself to producing some figures from the Electrical Exhibition of 1881. He does not seem to be aware of the progress made since that time.

He discusses the experiments of M. Marcel Deprez, and endeavors to prove that the return did not exceed 36 per cent. He criticises the use of the high tensions (2,120 volts) with which the wondrous results were obtained. He asks whether more than five or six horse-power can be sent to a distance, and refuses to admit that the return is independent of the distance. We have clearly stated our opinion on this question, and regret that a *savant* like M. Tresca so severely condemned experiments that should be encouraged. Whatever may be the outcome of M. Deprez's efforts, he has the merit of at least compelling attention to the matter, and causing investigation that will be industrially useful, sooner or later—others may succeed better, but he and his friends will have paved the way for them.

What M. Tresca disputes in the electric transmission of power is a superior return to 25 per cent. of the work furnished by the initial motive power. If we take a waterfall, for instance, we must, according to him, take into account the losses resulting from the motor, the wheel or turbine, from an intermediary transmitter at the set off, to give the required speed to the generator; from the passive resistances of the generator and receiver, from the electric resistances of the machine and conducting wire, and from an intermediary transmission at arrival, to moderate the velocity of the generator. If a return of 50 per cent. is admitted, only the half of this could be obtained after such changes. We should like to know what would become of the return of the telodynamic cable and compressed air when submitted to such a minute analysis; we very much question whether 90 per cent. of the initial work would be obtained.

The following may be mentioned among the applications of electric transmission of power to a distance:

IN WORKSHOPS,

running machine tools, ventilators, sewing machines, the electric machine may be put up in the place of the pulley or common transmission cone; a stop box can be used to graduate the velocity according to requirements. All belts are thus done away with, and a considerable saving in cost and power is effected. The substitution would be very advantageous for lathes, shaping and moulding machines.

IN MINES,

windlasses, ventilators, borers could be worked from a distance and small wagons run in the galleries. The cables and machines do not take up much room, and can be placed without any expensive preparations, while they are easily moved as the galleries are advanced.

ELECTRIC RAILROADS AND TRAMWAYS.

There are several specimens of electric railroads; Messrs. Siemens' Brothers intend to build one in London. The application to tramways is being examined, but success will depend principally on the accumulators, the merits of which have yet to be proved.

THE TRANSMISSION OF NATURAL POWER TO A DISTANCE.

At least ten horse-power must be furnished on the shaft of the receiver; with the views of M. Tresca and his product of 25 per cent., the receiver should have from 30 to 40 horse-power. It is safe to believe, however, that a return of from 45 to 50 per cent. may be had, on the condition of not being deterred from using copper conductors and powerful machines.

The above list will dispense us with any further refutation of the ideas of M. Tresca. Compressed air and telodynamic cables could be hardly used in the above cases and for the same services, as electricity; and if no entirely satisfactory solution has yet been arrived at, the field for experiment is too vast for inventors to feel discouraged.

This use of the electric current was hardly dreamed of five years ago, and when we see the progress made since then, success becomes only a question of time. The electric transmission of power was first made known at the Vienna Exhibition in 1873; that of 1883 will show the variety of resources that it can now place at the service of industry, and we have no doubt that there will be some unexpected revelations made.

Illumination and the transmission of power are the only two applications of electricity that have been seriously studied in France up to the present. They are also, it is true, the two that are best adapted for public exhibition, and for this reason, were special favorites with the "promoters" of joint stock companies. We do not believe that there remains very much more to be done in this line, and inventors must, therefore, turn their energies to another direction. Galvanoplasty or electro-plating is too well understood at present to leave room for any important discoveries in it; but the manufacture of chemical products may be completely transformed by electricity. The soda manufacture is especially deserving of attention in this line. The decomposition of chloride of sodium by the electric current will give us some day, perhaps, not only hydrate of soda, but the chlorides that are used in the bleaching of textiles and paper pulp. Several patents to this end have been already taken out, but the tests have not been altogether satisfactory. The extraction of the precious metals from their ores offers another wide field for electricity. There are silver mines in Peru and Bolivia, that have been abandoned on account of the enormous cost of transporting any ore with a less percentage of six per cent. of silver. Hitherto, all the attempts made to heat them with electricity have failed, whenever it was sought to operate on a large scale. New experiments are now being conducted in Paris, and we shall take the opportunity of speaking of them as soon as any definite results have been attained. Nothing is apparently more simple than the decomposition of a metallic compound by the electric current, but when the operation is to be put on an industrial basis, all kinds of difficulties are encountered, by reason of the irregular composition of the raw material, the lack of uniformity of the baths, the extent of surface of the anodes, &c. The matter requires to be studied; the numerous processes patented in Europe by André, Lambotte-Doucet, Lestrange, Blas and Miest, show that a practical solution is still far from having been found. Mr. Keith, an American, seems to have succeeded better than any one else in this delicate operation, but even he has confined himself to one metal—lead.

The applications of electric light, outside of workshops, and the large retail stores, are rather limited in Paris. We may, therefore, say a few words about two cases in which the light has been lately utilized; the one, in the Molieré circus, and the other at a performance in a club.

In the circus a track of sixteen yards in diameter had to be illuminated—the track is used for equestrian performances, gymnastics, &c. The building covers an area of more than 300 square metres, and the height to the summit is about ten metres, which corresponds to a cube of 2,500 metres. Jablochkoff candles, with rough round globes, were used so as not to frighten the horses or tire the eyes of spectators. Eight candles were placed along the track at a height of sixteen feet, each gave a light equal to from 200 to 250 candles—the globe lamp causing a loss of from 30 to 35 per cent. of the luminous tendency.

The effect was eminently successful; the light, which was equally distributed, was equal to that of day, and the greatest praise that can be given to it is, that no one paid any attention to it. The Jablochkoff candles are now made with the greatest care, and there is thus no longer any variations of brilliancy or color, which at one time gave such reason for complaint. The combustion takes place evenly, without any jerking, and no trouble is experienced even from a change of candles. The Jablochkoff candles furnish the most simple and agreeable system of electric illumination, when the powerful lights of regulators are not required.

The eight lamps, which were divided into two series, were fed by a gramme auto-exciting machine, and an engine of six horse-power. The chandeliers were of the eight candles' model, which gives a combustion of at least twelve hours—of course, more than required. The whole was put up by the Electric Lighting Company, and although improvised, it gave entire satisfaction.

The second application was made in the rooms of the Club de la Rue Royale, by means of Faure-Sellon-Volckmar accumulators. There does not seem to be much confidence in France as to the industrial future of accumulators; they are considered as having but a very narrow field of usefulness—in laboratories, and workshops—where the excess of motive power can be used for charging them to feed a few incandescent lamps. The trouble in making them up, the uncertainty as to their average duration and storage capacity, are not calculated to encourage their use. The company that is "working" the Faure-Sellon-Volckmar accumulators in Paris, adopted the plan of carrying the accumulators in a wagon, to the home of customers of electric light. All that is required is to connect the circuit of the lamps with the terminals of a series of accumulators in order to produce the light. The Swan lamps are usually used. A standard lamp placed under the wagon enables the operator to follow the discharge and to put in new accumulators, according as the old ones are exhausted. Here we have a probable application of the accumulators, but it is only for a large city, where electric light is sufficiently in demand to admit of heavy expenses in plant and labor; it cannot be said to be an industrial use.

Incandescent lamps cannot be introduced into private houses until a small, cheap, and simple motor is found. Gas motors do not fulfill the requirements so far, and are besides, so irregular in their work, that all kinds of trouble arise when an attempt is made to regulate them.

Several plans for an electric railway have been laid before the Paris municipal council anent the building of a metropolitan line, but none of them seems to have been satisfactory to the committee that has the matter in charge. It is well to state, however, that they were examined in a very superficial way. The chairman confined himself to stating that electric traction could not fulfill the requirements of passenger traffic. This is sufficient to make us forego an invention that has proved very satisfactory in Berlin and in Ireland, and which, according to the most competent electricians, has a great future.

We will only mention the names of the engineers that examined the question from the Paris point of view: M. Chrétien, who first drew up a plan for an aerial electric railway, and M. Boistel, who wanted only to provide some of the old exterior boulevards.

We regret the decision of the committee, as the net work of the Paris metropolitan service can only be finished by adopting the aerial system, as in New York, along with electric traction. It would require too much space to prove this, and we should have to enter into general considerations that would be out of place in an exclusively electrical journal.

PH. DELAHAYE.

—— IT IS STATED, that applications for patents, for electrical inventions, come in at the rate of from six to twenty a day, and that fifteen days fills a 500 page record of actions in electrical cases.

SOME NEW PHYSIOLOGICAL RESEARCHES ON THE TORPEDO, OR ELECTRIC EEL.

M. H. STASSANO presented a paper on the above subject at a recent meeting of the *Académie des Sciences*, which we here translate:

"The histological researches of M. Ranvier, on the nerve terminations in the electric organs, have led to the following conclusions: 1. The termination is made by a series of branches. 2. When a nervous tube enters an electric lamina, it presents a group of large nucleus in the interior of the sheath, recalling the termination of the motor nerves in the voluntary muscles.

"From a physiological point of view, the termination of the electric nerves was first made by Armand Moreau, in his experiments with curare on the eel. These experiments showed that paralysis of the electric nerves ensued a little later than that of the muscular nerves. M. Boll repeated the same experiments in Germany, but he obtained different and even contradictory results.

"I have lately repeated the experiments of Moreau, but I employed artificial respiration for the eels. I fixed an india-rubber tube to the mouth of the electric eel, which brings a regular supply of aerated salt water to the gills of the fish. I previously made a ligature of the œsophagus, so as to prevent water from entering the stomach. I sometimes, however, merely compressed the abdomen. If the eel is raised by the tail, at the beginning of the action of the curare, it will twist and turn, and try to touch the hand of the operator with its electric organs. These, at this period, can still emit strong discharges, but the electric movements and discharges grow weaker afterwards. All the movements are not paralyzed however, at the same time. Fifteen minutes after the injection the eel cannot twist itself when raised, but it can make some side movements now and then—soon these even are no longer perceptible. It might be thought that the eel is then completely paralyzed, but a few starts are observable from time to time—a careful examination shows that certain voluntary movements still exist. In fact, if the mouth is opened, the eel shuts it snappishly, and thrills run through its body. The paralysis can only be regarded as complete when the mouth does not shut again. At this period of the *curarization* the paralysis of the electric nerves is shown in turn.

"To show this progressive and simultaneous enfeeblement of the muscular contractions and electric discharges, I used the telephone, as recommended by M. Marey. The telephone is far better than the galvanoscopic frog, which I had hitherto used. For instance, when the electric power of the eel is weakened, a frog, prepared by the galvanic method, when placed on one of the faces of the electric organ, will no longer be contracted, and yet the contractions may be produced by bringing together with two fingers of the hand (thus forming a conducting arc), the two faces of the same electric organ, and of which the tensions are contrary. The use of the telephone dispenses with this trouble, because the electric organ is placed between two tin sheets joined to the telephone.

"Thanks to the artificial respiration, the change of the blood gases will continue to be made regularly in the gills. The other functions of vegetative life are carried on normally. The poison is nearly eliminated, but I have remarked that the electric discharges will reappear before the fish has entirely recovered its mobility. In fact, if the eel is excited towards the last period of the experiment, although it be still motionless, it will give small shocks. The fish soon recovers its movements, and the discharges then acquire their primitive intensity.

"The anatomic investigations of M. Babuchin prove that the electric organ is represented by a muscle in the embryon of the eel. The electric plates, which in the end almost entirely replace the muscular tissue, appear later. I say 'almost entirely,' as there is a great deal of resemblance, as M. Ranvier has shown, between the cellular lamina, with several layers of electric plates, and the primitive bundles of striated muscles.

"On the other hand, it has been shown by M. Marey that the electric discharge, considered from its retardation on the stimulation, as well as from its duration and phases, comports itself like a muscular contraction.

"The following experiments were made in order to connect these facts:

"1. I injected a muscular poison—the essence of bergamotte or digitaline—into one of the electric organs of a torpedo. The fish in a short time gives no discharges from the side where the injection was made. The eel grows weaker, according as the poison is generally absorbed. The cessation of the activity of the other electric organ precedes complete muscular paralysis.

"2. I passed a series of inducted currents through one of the electric organs. If the fish was then excited, even very much so, it does not react electrically on the side that the currents have been passed. It acts in this like a muscle in state of tetanus, which does not contract when its motor nerve is excited. On the other side, but only at the beginning of the experiments, some small discharges are still noticed.

"If the current is suspended, the electric shocks appear from all sides, and though the experiment be repeated several times, the same result is obtained, although it is seen that the eel grows a great deal weaker.

"I injected strychnine in an eel, that was put under *anæthesia* by a continuous-current of sea water mixed with sulphuric ether, running on the gills. The torpedo became altogether unconscious under the ether, and emitted no discharges; but after the injection of the strychnine the discharges reappeared violently; tetanus supervened only ten minutes later. Tremblings of the body were seen at short intervals, while the telephone gave a series of very violent knocks, even at some distance, and these followed one another rapidly, and plainly showed the tetanus of the organ."

THE BREGUET BURGLAR ALARM.

THE idea of making use of an electrical contact to automatically proclaim the opening of the entrance to a distant apartment, or the door of a safe, is by no means new, and many long standing patents may be re-called which have been taken out with a view of securing to their possessors the ownership of this device, and the privilege of its industrial promotion.

But if the systems are numerous, they are not thoroughly efficacious; for, unfortunately, those who are naturally, or by profession have become, burglars, are generally intelligent enough to understand the majority of them, and regard them with indifference. A wire adroitly parted, and the inconvenient alarm bell is silenced.

With the new alarm of Breguet this resort is denied the burglar, for should he cut the wire his visit will be announced, and if he do not cut the wire, the slightest movement of the protected window or door, determines precisely the same result. Thanks to this new combination, a depositary of money becomes the object of an enforced respect, an idol which can not be touched without its protecting guardian be immediately notified.

The fundamental and new idea of the system is as simple as ingenious. It is the application of a continuous current, and a device which causes the alarm to ring when the continuous-current is interrupted. An ordinary bell alarm, a constant battery, a Leclanché battery, and some contact pieces, which are disconnected when the protected apartment is entered, are all the constituents of the system.

The constant battery may be located in any convenient place, and furnishes a current which traverses a circuit completed through the house wires, the contact pieces and the coils of an ordinary electro-magnet. The armature of this electro-magnet is, therefore, usually attracted; but if, by the interruption of the constant current, it be released, a spring causes its carrier to rise and brings together a pair of platinum contacts which complete the circuit of the Leclanché battery through the alarm bell, which rings continually until the main or constant current be re-established. Nothing restricts the number of alarm bells or their location at various distant places. If the main current be interrupted at any point whatever, all the bells of the system will ring at once.

The use of the continuous-current also prevents the possibility of the system becoming in-operative, for, if by negligence the constant battery be allowed to fail, the fact is immediately proclaimed by the ringing of the alarm.

The constant battery, however, operates a long time without renewal of its contents. Breguet employs the Trouvé battery, which is maintained at very little expense. Its function being in effect limited to maintaining an armature in contact with an electro-magnet, which, as is well-known, a very moderate current is competent to serve

Thanks to the Breguet system, we are protected against the operations of the dangerous classes, and we believe that few burglars have a sufficient acquaintance with electric science to devise a means of thwarting the new combination we have described.—*La Nature.*

EXPERIMENTS WITH ELECTRIC ACCUMULATORS.

At a recent meeting of the Physical Society, of Berlin, Dr. Aron reported on the accumulators, on which he has been making experiments for several years past. Even before M. Faure's discovery, at the time when M. Planté announced his first essays with the secondary batteries, Dr. Aron was endeavoring to determine a convertible electric element, which, being theoretically possible, might also be available for practical purposes. He first of all tried to make the Daniell chain convertible by using, instead of the two amalgamating fluids, hydrate of soda and sulphate of copper, which do not amalgamate, but without success. Like many others, he repeatedly tested Planté's already published statements, regarding convertible cells of plates of lead, immersed in dilute sulphuric acid, and which had to be charged in a very definitely prescribed way, but without any certain results. The cell sometimes became charged and discharged alternately, at other times not. He accordingly tried plates of lead which had been previously crystallized by corrosion, and these he found far more reliable. He therefore constructed accumulators of plates of lead in sulphuric acid, to which some nitric acid had been added. Although more certain in their application, these were by no means equal to the practical requirements. The favorable results of the corrosion, as regarded the crystalline surface, a point also confirmed by Planté himself, was explained by Dr. Aron, who attributed it to the disintegration of the metal. He therefore tried to increase the effect by using lead sponge, but without result. At that time he also thought of red lead, but made no experiments with it, because he knew of no means of fixing this powder to the lead plate conductor. It is now known that M. Faure simply spread the red lead on the plates, and thus produced his powerful accumulators possessing great storage capacity. When this became known, Dr. Aron carried out an extensive series of similar experiments, in order to test its practical value, and even increase it. For the latter purpose he introduced a substantial improvement, by attaching the red lead with collodium, which in the practical application of the chains is of course out of the question. But as regards their practical utility, the accumulators have fallen far short of the hopes generally entertained of them. The main difficulty lies in the thin plates of lead, which, when thickly covered with red lead, although very effective, become corroded and useless after being once used, while thick plates, by the formation of sulphate of lead, are rendered ineffective. As to the theory of accumulators, to rightly understand it, it is very important to bear in mind the fact established by Messrs. Gladstone and Tribe, that in the cell, consisting of two plates in dilute sulphuric acid, the electric current changes the sulphate of lead generated at the positive pole into peroxide of lead $PbSO_4 + H_2O + O = PbO_2 + H_2SO_4$, whereas at the negative pole the sulphate of lead is simply decomposed into sulphuric acid and disintegrated lead. Hence, after charging, the cell consists of $Pb \mid H_2SO_4 \mid PbO_2 \mid Pb$, a combination which yields a very powerful discharge, available also for a protracted period. To this theory it has been objected that at the negative pole the sulphate of lead cannot be decomposed into lead and sulphuric acid; but Dr. Aron has satisfied himself that, under the influence of the hydrogen beginning to be generated, very thin layers of sulphate of lead become so reduced, thicker layers alone resisting decomposition. The process at the positive electrode being really such as is described by Gladstone and Tribe, the above theory of accumulators may, broadly speaking, be accepted as correct. As regards the peroxide of lead, the speaker pointed out that this combination is admittedly of a brown color, whereas the substance deposited on the positive plate is black. From a more searching examination of this substance it resulted that it is not the peroxide but a hydrate of the peroxide of lead; and Dr. Aron suspects that there is here less question of a hydrate PbO_2H_2O than of a combination of the oxide of lead with a peroxide of hydrogen. A series of theoretically interesting isolated phenomena may possibly be produced by following up the processes here in question; but in the present conditions Dr. Aron holds the practical application of the accumulators to be hopeless.—*Mechanical World.*

A FIGHT FOR LIFE IN A TUNNEL.

The following narrative, from Mr. Hiram S. Maxim, the electrician, appears in *Galignani's Messenger*, Paris, June 9:

In the summer of 1881, when I came to Paris, in connection with the electrical exhibition, at the Palais de l'Industrie, and while staying at the Grand Hôtel, Boulevard des Capucines, I was robbed of ten thousand francs in a very ingenious way. Of the two thieves who robbed me, one was a large man, calling himself an American naval captain, and having cards engraved to that effect; the other was an average sized man, and purported to be an Irishman.

After losing my money, I took measures to find out more about these men. I found that they were expert English thieves, and, by inserting advertisements in American, English, and French newspapers, I was brought into communication with some of their victims. I learned that these men had certainly stolen more than 175,000fr. from Americans in Paris (the actual sum is doubtless much greater), and that they had been carrying on this proceeding for some six years. I endeavored, in every way, to bring these rascals to justice; but, nevertheless, they continued to steal, and to get away. Whenever they succeeded, they left at once for England, and remained there until their victim quitted Paris. I, however, stayed so long in Paris, that their plans were considerably hampered. Nevertheless, these men returned to Paris, but, instead of conducting their operations, in the vicinity of the Grand Hôtel, they practiced in the vicinity of the Palais-Royal and Champs-Elysées.

While in London, about a year ago, I met these two men in the Strand. I arrested the smaller man—his companion escaping—and led him in triumph to Bow Street police station, where he was searched. He had a large amount of false English bank notes upon him. He was detained for the night; but, upon being brought up at the police court, the following morning was released, owing to the extradition treaty not applying to cases of theft, and the man had made no attempt to pass his bogus money in England.

I learned that the supposed naval officer was named Jack Hamilton, and that he had acted as second to John C. Heenan, in the great international prize fight between Heenan and Sayers. The other man's name I found to be John Palmer—a racing sharper and thief, passing himself off as an Irish Lord. Both these men lived in London, Hamilton at ——, and Palmer at 81, Chadwick Road, Peckham, S. E.

About ten days ago, these thieves robbed a Mr. Williamson, the editor of a New York paper, of $400, in American gold, a valuable gold watch and chain, and a gold ring; from this robbery, I concluded that these thieves were in Paris. I received information from the London police that these men would be present at the *Grand Prix* last Sunday. I therefore went to M. Macé, the deputy chief of police, and persuaded him to send two detectives with me, to Longchamps, in order to effect their capture. We did not, however, succeed in finding them, though they were on the field.

On the evening of the 5th inst. I left Paris for London, *via* Dieppe and Newhaven. Upon the arrival of the train at Rouen, I alighted, and noticed a group of five Englishmen standing at the refreshment bar. Two of these men I at once recognized as the men who had robbed me, and their companions were probably members of their gang. Without delay, I seized upon John Palmer, the head of the gang, and dragged him to a distance of about ten feet from his four comrades. I grasped him firmly, and he struggled violently to get free. I called for the police, and stated to the bystanders that I was capturing a thief who had robbed me, and I asked for a policeman, but none was to be found. The interpreter at the station, however, said he would fetch one, but before the policeman arrived the four others had entered their carriage, and the train started.

When the train had got up a fair speed, Palmer, whom I held, made a tremendous effort, slipped out of his coat, leaving it in my hands, and rushed for the departing train I pursued him, and gaining on him, caught him just as he got on the foot board. He made a desperate attempt to throw me under the carriage wheels, or beat me off. I succeeded, however, in gaining a firm foothold, and passing one arm through a window I held on to the thief with the other hand. He could thus neither throw me off, nor get off himself, neither could he reach the carriage in which his comrades were seated, who were doubtless ready to assist him. The train ran rapidly into the tunnel, and I found myself in darkness Many passengers looked out of the window, and screamed. The great confusion caused a signal to be given to stop the train, and when the speed was sufficiently slackened, I jumped off the foot board, dragging my prisoner with me, and, notwithstanding his vigorous exertions to escape, I forced him out of the tunnel, where I was met by the interpreter. The thief immediately gave this man a savage kick.

Upon my arrival at the station, two policemen put in an appearance, but I did not relinquish my hold of the prisoner until he was safely handcuffed. I earnestly requested the police to telegraph to Dieppe, in order to arrest the remainder of the gang on the arrival of the train at that town, but to no purpose, as an hour and twenty minutes elapsed before I could induce them to take action, and even then, I had to pay for the telegram myself.

On the way to the police station, the prisoner conversed freely with me, and said that if I would refrain from accusing him he would refund my money and pay all expenses I had been put to. He added that he wanted to go to London, and not to Paris, that I should gain nothing by detaining him, but if I released him I should "make something out of it; in fact, something handsome" I told him that it was not a question of money with me, but a matter of principle, and that I should make the charge at all events. I told him that he had robbed several of my countrymen, that it was only justice that he should be punished, and that he would probably be an older man than he then was before he again visited London.

At the police station he was searched, and Mr. Williamson's ring found upon him. The following morning I saw him at eight o'clock, and he again tried to persuade me to make no charge against him I advised him, in view of the fact that there was positive proof of his guilt, to plead guilty. Upon being taken before the chief of police, he did plead guilty, and will probably be brought to Paris soon for sentence.

Among the victims of this gang may be mentioned several clergymen, and one bishop. The largest loser, however, was a Mr. Wales Tucker, a well known and highly respected merchant of Boston, U. S. A.

The only injuries which I received during this fierce and protracted encounter, was the turning back of three of my finger nails, and tearing the sole from one of my boots.

HIRAM S. MAXIM,
25 Avenue de l'Opera.

Paris, June 8, 1883.

A DESPATCH FROM PARIS, June 22, says: at a dinner of electricians, last night, Count de Lesseps made a speech, in which he appealed to the persons present to compete for a prize to be awarded for the best means of lighting the Suez Canal by electricity.

A CONTINENTAL PAPER says: "With a view to procure the high tensions and extensive quantities of electricity necessary for the transmission of a large amount of labor, and with a good yield, M J. Moser proposes to arrange a large number of machines in a battery, *i. e.*, partly in tension and partly in quantity, the same as he has done with bobbins of telephones in the case of his telephonic transmissions. For the purpose of experiments, the existing and accessible machines may be used, run at ordinary tension and speed. In this way experiments are [illegible] and the accidents avoided which are sometimes brought on by [illegible] of speed and tension."

SPARKS.

—— IT IS RUMORED that Prof. Elisha Gray will shortly erect an electrical college and experimental observatory, at Highland Park, Chicago, Ill.

—— THE LONDON *Daily News*, June 4th, gives a despatch from Vienna, as follows: "Last night, Baron Rothschild's carriage was lighted by electricity, the accumulators were placed under the coachmen's seat. The electric lights were inside the usual lamps."

—— THE *Mechanical World* says: "A non-conductor of electricity has yet to be found, for all substances hitherto discovered are conductors of the force, under certain known conditions; but those which offer a great resistance to it, serves the purpose of non-conductors in practice, although they may be all classed as good or bad conductors. The best conductor at present known, is silver; the worst conductor is solid paraffine."

—— IT IS STATED THAT a Montreal firm has invented and patented a machine for cooking by electricity. It consists of a saucepan so isolated by non-conductors, that the bottom forms the positive pole of the current. The negative pole is attached to a movable point, which travels in circles over the bottom of the pan underneath, distributing the heat over the whole surface, and with sufficient rapidity to avoid burning a hole through the pan at any one point.

—— A MATHEMATICIAN, of Salem, Mass, has figured up that the city lamp department could have bought 220,000 single matches with the $36.10 expended for lucifers last year. After allowing one match for each time a lamp is lighted, and also the use of gas lamp lighters, the mathematician figures out that 114,500 matches are unaccounted for. This deficiency does not appear strange to any one who has seen people borrow a match of a city or of a corporation, for "a match" generally means a vest pocketful, which will supply the demand of family and pipe until another borrowing visit is made.

—— A DESPATCH from Luray, Va., June 15, says: To-day, during a heavy storm, and while guides were showing a large party through the Luray caverns, the lightning struck one of the electric light wires and was carried into the caves, where it ran over the wires from one end to the other. The electric light globes were shivered into fragments, and the lightning gathered into big balls along the wire and exploded with loud reports. The scene for several minutes was terrific beyond description. The lightning flashing along the wires looked like fiery serpents. One bolt shot from the wires and shattered the stalactites of the bridal chamber. When it disappeared, some of the party were left in total darkness.

—— THE EIGHTEENTH BULLETIN of the Edison Co. reports that their plant in the first district of this city, runs with entire success. Has now been in operation since September 4th, without stopping one instant, day or night. That they are regularly gaining new customers, and connections with additional buildings are being made daily. That customers are entirely satisfied, both with the light and the price, and the present indications are, notwithstanding the fact that in summer but little light is consumed as compared with winter, that they will soon make connections enough with customers to exhaust the entire capacity of the station. They say they are at present lighting 429 houses, wired for 10,268 lamps.

—— *Engineering* says: An experimental lighting of the Court Opera House, at Vienna, by the electric light, recently took place before a large audience of invited guests. The first scene was laid in a room in which broad daylight was gradually changed through dusk and twilight into heavy night. This experiment went off with surprising steadiness, and at the close the audience broke into loud applause. After further experiments came a trial of costumes under various degrees of lighting. About fifty "supers," male and female, were assembled on the stage in dresses of varied hue and texture. The electric light showed up the colors of the dresses perfectly, without any of the materials losing their brilliancy. After this there succeeded a landscape scene, in which bright daylight was followed by slow degrees of evening red, sunset, moonlight, morning glow and sunrise. After this the proceedings terminated with a thunderstorm, and the audience left with high expressions of approval.

—— A LETTER from Paris, June 12th, informs us, that we may expect to see at the Vienna exposition, machines for the electric transmission of force, giving 50 to 68 per cent. at a distance of 2,000 metres; that there is, at present, a slight fall in the stock of the Societe Generale Telephone, of Paris, due to speculation without any accountable motive; that the house of Lazare Weille, manufacturers of phosphor and silicious bronze for telephonic and telegraphic wires, has been organized into a company, that they expect Government orders, and propose to sell the patents for the United States; the writer says, accumulators are somewhat compromised by the arrest of M. Phillapart; that it is proposed to introduce the Clamond burner in competition with the electric incandescent system, and that the naptha and gas lighting system has apparently died out.

—— THE *Times-Democrat*, New Orleans, says: Dr. Tanner, whose reputation is mostly due to his long fast in New York city, is now residing in Jamestown, N. Y. His present hobby is electricity. Tanner contends that the human organism is a machine run by a force. That force he assumes to be electricity. He further claims that this subtle motor force, is the energizing principle in food; that it is contained also in the water we drink and in the atmosphere we breathe. He assumes, also, that electricity is the cohesive power that holds all particles of matter together, mineral as well as vegetable and animal. He believes that the time will soon come when the minerals will be utilized for food; that is, this energizing principle in metals will be evolved by manipulations, and made subservient for good by supplying man with the most potent of all forces in nature.

—— THE COMMISSIONER OF PATENTS, says the *Patent Office News*, on the 24th of May rendered decisions in two of the Edison-Gray interference cases, which have been attracting considerable attention of late, in both cases sustaining the decisions of the examiner-in-chief, from whom appeals had been taken, and awarding priority of invention on the magneto generators in dispute, to Gray; and that the Examiner of Interferences has rendered a decision in the case of Sawyer & Man vs. Edison. The invention involved "the incandescent conductor for an electric lamp formed of carbonized paper." The case was originally decided in favor of Sawyer & Man, January 20, 1882, but it was subsequently re-opened, and referred back to the Examiner of Interferences, on the application of Edison, who represented that he had new and important testimony to offer. Mr. Church reviews the testimony at length, going over the whole ground carefully, and then holds that Sawyer & Man must be adjudged to be the prior inventors. He finds that "after a careful examination of the entire record, it must be held that Sawyer & Man reduced this invention to practice at least as early as the autumn of 1878," and that "the earliest date the invention can be accorded Edison, is in the autumn of 1879." Sawyer & Man's application was filed January 9, 1880, and Edison's December 11, 1879.

—— A COTEMPORARY SAYS, that a wealthy citizen of Mauch Chunk has made a novel bequest to that town, of such utility that it deserves to be made known throughout the entire country. He has provided an electrical attachment by which the time of the clock in the telegraph office of the Lehigh Valley railway is struck on one of the large bells of the chime of St. Mark's church, and as the telegraph clock is regulated at noon daily, it is very easy for all the people of Mauch Chunk to have their time-pieces correct. A time bell has also been placed in the church, and it drops precisely at noon, after the manner of the time ball on the Western Union building in this city. A similar attachment might, advantageously, be provided to strike the correct time in every town in the republic which has a telegraph office. Costly town clocks cannot be provided in many of the smaller villages, but the hours may be struck on church bells without costly clocks, if the Mauch Chunk electrical apparatus be employed. It will be a great convenience to a large part of the population of the entire country to have the time of the telegraph clocks struck on the bells nearest to them, and when a uniform system of time for the world is adopted, by means of electricity, the clocks of each meridian can easily be made to tick in unison.

—— AT A LOCAL MEETING of the association of German engineers, recently held at Siegen, Herr Macco gave an account of a practical method of getting coal by electricity, which has been employed in the coal mines of Zankeroda. The coal wagons are conveyed by electricity, in a cross cut of about 2,300 feet in length, to the winding shaft, at a speed of from 6.56 to 9.84 feet. In ten hours, seventy wagons of 15 cwt. each, are delivered in that way. The depth of the winding shaft is 820 feet, and the length of the electric conduit is no less than 3,116 feet. At the top of the winding shaft a series of T-irons, soldered to one another, is fixed, upon which the trollies travel, and these, in their turn, are placed in communication with the locomotive engine.

—— THE *Industrial World*, of June 14, in an article referring to the management of the railway exposition, at Chicago, says: Some little talk has been made about what has been designated as the monopoly secured by the electric light companies. As we understand the matter, the companies supplying arc lamps contracted to furnish each 40 lamps to the exposition for the free use of the exhibitors. It was stipulated that if the latter desired other lamps, they could have them at the rate of $25 per lamp, or about $1 per night. The electric companies had no other way of recovering in whole or in part their expenditures in furnishing the free lights, and the exposition company could not afford to go to the expense of lighting the building, so extensively, at its own cost, as this would require an outlay of not less than four or five hundred dollars per night. The incandescent lights are furnished free. If there can be anything looking towards an unfair monopoly, in the above arrangements, we are at a loss to find it.

—— THE NEW ORLEANS *Picayune* states that, on June 11th, the sale of the stock of the Louisiana Telephone Company was completed, and the cash paid over by the purchasing company. An election for officers under the new company was then entered into, and Mr. E. S. Babcock, Jr., of Evansville, Ind., was elected President, vice John N. Bofinger, who retires. The valuable services of W. H. Bofinger, were, however, retained, as he was elected Vice-President and General Manager of the new company. Capt. Paul J. Marr, of Nashville, Tenn., was elected Director, vice Mr. W. W. Houck, who, however, as Secretary and Treasurer, still remains with the company. The public, as well as the new company, can congratulate themselves at having retained the services of Messrs. Bofinger and Houck. To them is due the success of the telephone service in this city heretofore, and it was owing to their energy and enterprise that so many new lines were established and the rapid increase was made in the number of subscribers. No further change in the employees of the old company is contemplated.

—— THE NEWARK *Advertiser* reports that the Overland Telephone Company, of New Jersey, is a new organization lately established, with headquarters in Newark, N. J. It holds its license for the entire State from the parent company of the same name, which has its office at No. 171 Broadway, New York, and of which R. G. Dun, of mercantile agency fame, is President, and a number of telegraph and financial men of good standing are Directors, The New Jersey Company has filed its certificate at Trenton with the following incorporators: John H. Eastwood, Charles Heath, Thos. C. Provost, Winfield S. Sims, and Benj. F. Roby. The offices of the company are located in the building of the Firemen's Insurance Company, No. 784 Broad Street. They have a number of instruments in operation, and expect to do an extensive business. The telephones are of a new pattern, and do not infringe the rights of other companies. The especial advantage of the new telephone is in long distance conversation. A feature of the invention is the adjustability of the telephone to all kinds of work. A reporter who visited the office this morning tried the telephone and found that it worked with great clearness. It is probable that business men of Newark will find it of use in conversing with other cities, Trenton for instance. The new company will do business in various parts of the State, but there will be no interference with the Newark corporation, which now controls all the business in this city under the Bell telephone patents. The officers of the company are John H. Eastwood, President, and Benj. F. Roby, Secretary. Frederick T. Fearey was elected a Director at a recent meeting.

—— *Engineering* says: A useful form of battery has been brought out by the British Insulite Company, Limited. The cell is sealed, and therefore can give off no fumes into a house where it may be employed for bells or other purposes. The outer vessel, which is rectangular, is made of insulite, a material impervious to liquid and self-cementing. A partition of porous clay is cemented diagonally across the cell from corner to corner. In one corner is a zinc rod and in the other is a carbon rod, surrounded by pea-like pieces of carbon. A special solution is employed to excite the battery. The connections are made by binding screws on the lid, in which there is also a release valve to provide for expansion of the air within. The cell, when sealed, can be inverted or put in any position without damage. The battery lasts two years without renewal of zinc, and is well fitted for bell work.

—— THE LATEST DIRECTION in which the electric current has been utilized, is in connection with the extraction of gold from its ore by the process of mercurial amalgamation. In this process, great difficulty is frequently experienced from the mercury becoming sluggish, or "sickening," as it is termed. This sluggishness is occasioned, mainly, by the presence of copper and iron pyrites, and other substances which are inimical to the profitable extraction of gold. This has, in some cases, prevented valuable deposits of gold being worked, while, in others, the effect has been to diminish the yield to a considerable extent. The matter having been carefully investigated by Mr. Richard Barker, F.G.S., he at length found that, by passing a current of electricity through the mercury and the water, which carries the pulverized ore over the mercurial bath, the latter retained its full vigor and activity, readily seizing the atoms of gold, and never becoming sluggish, no matter how inimical to its healthy action the substances passing over it may be. The apparatus consists of an inclined table, about 20 feet long, and varying from 3 feet to 6 feet in width, in which are placed, at intervals, "riffles," or baths, containing the mercury. Over this table the pulverized gold ore is led, by means of a gentle flow of water, in the usual way, passing over the baths in its course. The negative wire from an electric current generator —one of Elmore's, in the present instance—is connected with the mercury in the riffles, the mercury thus becoming the cathode. The positive pole, or anode, is introduced into the water, immediately over the mercury, and sufficiently close to it to cause an energetic action, but far enough from it to permit of the pulverized ore passing freely between the mercury and the anode.—*Ironmonger.*

—— PROFESSOR DOUGLASS, of Michigan University, at Ann Arbor, has succeeded in manufacturing miniature tornadoes by means of electricity. He suspends a large copper plate by silken threads and electrifies it. By the use of arsenious acid gas the electricity is made visible hanging downward from the plate in the form of a funnel. If the plate is passed over a table containing movable articles, the whirling motion of the electric charge sucks them up or scatters them hither and thither. The effects are exactly the same as those seen in destructive tornadoes. In the light of these wonderful experiments the development of a tornado is simple. A low lying cloud charged with vapor becomes surcharged with electricity, and the vortex descends until connection is formed with the earth. The whirling motion continues until an electric equilibrium is established. We may assume that the cloud is charged directly fror sun in a state of violent electrical commotion, like that which produced the electric storm of November last. The sun storm was then visible to the naked eye. During the prevalence of the electric convulsion the storm centre on the sun changed form with the greatest rapidity. There was a cyclonic motion of the sun's luminous atmosphere about the dark vortex, which is called a sun spot. Slowly, but surely, the mysteries of the sun and the earth are being unraveled. The discovery by the Ann Arbor professor is a great advance. No human knowledge or foresight can do any more than make preparations for the safety of human life from the tornado's sweep. An instance was reported yesterday morning in which a family was saved by the foresight which had provided an underground retreat near a residence which was swept away.—*Democrat and Chronicle*, Ann Arbor, Mich.

—— MR. W. A. STERN, electrical engineer of Philadelphia, addressed a very practical communication to the common council of that city, June 25th, on the question of putting telegraph, telephone and electric light wires underground, it concludes as follows: "Aside from all the objections mentioned, not one of these systems means an absolute doing away with all overhead wires. It simply disposes of the least objectionable ones, while making no provision for the house top or dangerous wires. You all know what obstruction these offer to the fireman. In addition to this, anything strictly underground would mean the tearing up of one's house. And I consequently hope that we will not be obliged to suffer this inconvenience, until we have a system that is complete. I strongly favor underground electric wiring, but not until we have a good system, and conscientiously say that that time has not yet arrived."

BUSINESS NOTICES.

WANTED, by a young man of large experience (now running 58 lights), a situation with an Electric Light Company, can furnish ample reference as to ability, &c. Address, A. J. C. care of ELECTRICIAN, Room 55, 115 Nassau Street, New York.

MESSRS. C. E. JONES & BRO., Electricians, manufacturers and dealers in Telegraph, Telephone, and Electrical Apparatus, 51 West Fourth Street, Cincinnati, desire to inform their patrons, that the recent fire on their premises will not interfere with their filling orders with their usual promptness.

THE WESTERN ELECTRIC COMPANY, agents in the United States for the apparatus of Sir Wm. Thomson, have imported a few potential and current galvanometers for testing dynamo-electric currents. These instruments are spoken of with the highest praise by practical electricians who have inspected and tried them. Like all the Thomson instruments they are finely finished and adjusted, and for delicacy, accuracy and range they are unquestionably superior to any others.

BRADLEY A. FISKE,
Consulting Electrical Engineer,
59 Astor House, N. Y.
Opinions, Calculations, Estimates, etc.

BOOK NOTICES.

THE *Quarterly Circular of Information and Advice* about Patents on Inventions, for June, published by Burke, Frazer, and Connett, 10 Spruce street, New York, contains articles on "Patents in Belgium," "Caveats, and when Useful," "Assignments and Licenses," "The Amendment of the Patent Law," "Experts in Patent Suits," "Condition of the Patent Office," "Proposed amendment of the British Patent Law." This publication will be sent (without charge) to any patentee or manufacturer, who sends a request to that effect, to the above address.

THE GLOBE TELEGRAPH CODE; London: Wm. Dawson & Sons. A very interesting article might be written on codes,—the modern necessities of business. Sometimes one might imagine that a new language might grow up, and that abbreviation in word and speech would be carried to the utmost. Surely, "Caloniaran," to be equivalent to "Dutch crushed sugar in hogsheads," is a great saving of time and money. In the present code all the ciphers are Spanish, and the arrangement of the work seems to be well adapted to all kinds of business. It is compact and cheap, and more philosophical in its principles than any other.

"HAND-BOOK OF MEDICAL ELECTRICITY," by Dr. A. M. Rosebrugh, Surgeon to the Toronto Eye and Ear Dispensary. The author claims to have made important modifications in portable galvano-faradic batteries. The treatise gives an account of its construction and method of working such a battery, and of the therapeutic influence of electricity as applied thereby. There is no doubt of the great benefits that may be had from judicious electric treatment in diseases of the nerves and muscles. Only physicians well acquainted with electric laws and the physiological effects of currents should be permitted to use such very powerful agents. The treatise is written in a practical manner, and gives the directions bearing on the use of the battery in various diseases.

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Assets, -	$48,025,751	Assets, -	$48,025,751
Liabilities,	37,367,076	Liabilities,	39,949,454
Surplus, -	$10,658,675	Surplus, -	$8,076,296

RATIO of Surplus to Liabilities of the leading life insurance companies on a four per cent. basis:

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EQUITABLE	$48,025,751	$39,949,454	$8,076,296	20.21
NEW YORK	50,800,396	43,760,183	7,040,213	16.09
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PATENTS FOR MAY AND JUNE, 1883.

MAY 22d.

278,159 Clock System, Electric Pneumatic. C. A. Mayerhofer, Paris France.
278,277 Electric Cables, Device for Suspending. H. C. Root, and J. C. Reilly, Philadelphia, Pa.
278,078 Electric Machine, Dynamo. C. E. Ball, Philadelphia, Pa.
278,119 Electric Machine, Dynamo. G. W. Fuller, Norwich, Conn.
278,120 Electric Machine, Dynamo. G. W. Fuller, Norwich, Conn.
278,121 Electric Machine, Dynamo. G. W. Fuller, Norwich Conn.
278,122 Electric Machine, Dynamo. G. W. Fuller, Norwich, Conn.
278,233 Electric Wire Duct. J. C. Goodridge, Jr, New York, N. Y.
278,009 Electric Wire, Machine for Covering. W. Halkyard, Providence, R. I.
278,096 Electric Wires, Curbstone and Sidewalk Conduit for. E. Clark, Jersey City, N. J.
278,289 Electrical Conductor. S. D. Strohm, Philadelphia, Pa.
277,965 Fire Alarms, Automatic Circuit Closer for Electric. J. O. Wells, Des Moines, Iowa.
278,087 Insulating Underground Electric Wires. W. M. Brisben, Philadelphia, Pa.
278,293 Lamp, Electric-arc. W. M. Thomas Cincinnati, Ohio.
278,304 Lamp Regulator, Electric-arc. A. I. Gravier, Paris, France.
278,028 Lightning Rod. A. C. Lobdell, Chicago, Ill.
278,036 Telephone Transmitter. J. A. Lakin, Westfield, Mass.

MAY 29th.

278,355 Carbon Plates, Apparatus for Making. E. J. Molera and J. C. Cebrian, San Francisco, Cal.
278,418 Electric Currents from High to Low Tension, Apparatus for Translating. T. A. Edison, Menlo Park N. J.
278,465 Electric Light Conductors, Support for. L. Stieringer, New York, N. Y.
278,516 Electric Machine, Dynamo. A. F. Delafield, Noroton, Conn.
278,419 Electric Machine, Dynamo. T. A. Edison, Menlo Park, N. J.
278,641 Electric Machine, Dynamo. E. Weston, Newark, N. J.
278,413 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park N. J.
278,414 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
278,640 Electric Machine Regulator, Dynamo. E. Weston, Newark, N. J.
278,353 Electric Switch-board. W. J. McElroy, Pittsburg, Pa.
278,635 Electrical Conductors, Protector Attachment for. W. E. Townsend, Jr., Brooklyn, N. Y.
278,346 Electrical Connector. H. E. Long, London, Ontario, Canada.
278,525 Electrical Distribution, System of. E. T. Greenfield, New York, N. Y.
278,638 Electrodes for Secondary Batteries, Making. W. Wallace, Ansonia, Conn.
278,596 Insulating Material, Electrical. J. Greives, Paterson, N. J.
278,618 Insulator Brackets, Machine for making Telegraph. J. B. Smith, Sunapee, N. H.
278,619 Insulator Pins, Machine for Making Telegraph. J. B. Smith, Sunapee, N. H.
278,642 Lamp Bracket or Fixture, Incandescent. E. Weston, Newark, N. J.
278,415 Lamps, Manufacture of Incandescing Electric. T. A. Edison, Menlo Park, N. J.
278,416 Lamps, Manufacture of Incandescing Electric. T. A. Edison, Menlo Park, N. J.
278,417 Lamps, Manufacture of Incandescing Electric. T. A. Edison, Menlo Park, N. J.
[illegible] J. A. McCoy, Fall River, Mass.
[illegible] Exchange Circuit. C. E. Scribner, Chicago, Ill.
[illegible] Exchange System and Apparatus. F. Shaw, New York, N. Y., and W. A. [illegible], Englewood, N. J.
[illegible] Apparatus. W. J. Dudley, Boston, Mass.
[illegible] H. W. Breckenridge, Providence, R. I.
[illegible] J. M. Oram, Dallas, Texas.
[illegible] System and Apparatus for Communicating. C. T. Dick[illegible] Ohio.
[illegible] R. Lemcke, Hoboken, N. J.

JUNE 5th.

[illegible] J. Happersberger, Cincinnati, Ohio.
[illegible] Commutator for. W. H. Chapman, Middlebury, Vt.
[illegible] Apparatus for Synchronizing Clock Pendulums. H. [illegible] N. Y.
[illegible] W. H. Sawyer, Providence, R. I.
[illegible] A. M. Loryea, and C. H. Palmer, New York, N. Y.
[illegible] and W. H. Chapman, Middlebury, Vt.
[illegible] and W. H. Chapman, Middlebury, Vt.
[illegible] Reading, Pa.
[illegible] Newark, N. J.
[illegible] Fanwood, N. J.
[illegible] Signaling. J. C. Wilson, Bos[illegible]
[illegible] Fanwood, N. J.
[illegible] W. M. Thomas, Cincinnati, Ohio.
[illegible] J. B. Atwater, Chicago, Ill.
[illegible] Chicago, Ill.
[illegible] and F. A. Swan, Boston, Mass.
[illegible] France.
[illegible] New York, N. Y.
[illegible] Springfield, Ill.
Railway [illegible] Brooklyn, N. Y.
Storage B[illegible] New York, N. Y.
Telegraph and Telephone [illegible] New Orleans, La.
Telephone Line [illegible] for Mechanical. G. F. Shaver, Erie, Pa.

JUNE 12th.

[illegible] London, England.
[illegible] Burglar Alarm [illegible] Boston, Mass.
[illegible] Carbon Plates, Manufacture of [illegible] C. H. Koyl, Baltimore, Md.
[illegible] Clocks, Electro-magnetic [illegible] H. Grau, Cassel, Prussia, Germany.
[illegible] Electric Conductor. J. W. Rogers, New York, N. Y.
[illegible] Electric Light. [illegible] Springfield, Mass.
279,476 Electric Machine, Dynamo. R. E. Ball, New York N. Y.
279,362 Electric Machine, Dynamo. N. H. Edgerton, Philadelphia, Pa.
279,899 Electric Machines, Armature for Dynamo. E. R. Knowles, Brooklyn, N. Y., and F. E. [illegible], Hoboken N. J.
[illegible] Electric Wires, Underground Conduit for. W. H. Johnstone, Philadelphia, Pa.
279,346 Electrode for Secondary Batteries. N. C. Cookson, Newcastle-upon-Tyne, County of Northumberland, England.
279,322 Fences, Electrical Device for Protecting Wire. C. A. Brainerd, Chicago, Ill.
279,472 Lamp, Electric. J. J. Wood, Brooklyn, N. Y.
279,512 Lamp, Electric. J. J. Wood, Brooklyn, N. Y.
279,363 Lamp, Electric-arc. N. H. Edgerton, Philadelphia, Pa.
279,152 Lamp, Electric-arc. J. H. Guest, Brooklyn, N. Y.
279,371 Measuring Electric Currents, Apparatus for. S. L. Fox, London, England.
279,327 Telegraph and Clock System, Combined. C. E. Buell, New Haven, Conn.
279,289 Telegraph and Telephone Line. T. N. Vail, Boston, Mass.
279,471 Telephone Switch Boards, Looping-in Mechanism for. E. M. Wilson, Worcester, Mass.
279,401 Telephone Transmitter. J. A. Lakin, Westfield, Mass.
279,193 Telephonic and Burglar Alarm System, Combined. W. S. Shoupe, Elyria, Ohio, and T. Buskirk, Toledo, O.

JUNE 19th.

279,861 Belt, Electro-galvanic. G. E. Palmer, Boston, Mass.
279,825 Electric-arc Lighting System. R. J. Sheehy, New York, N. Y.
279,634 Electric Circuit Cut out. A. L. Bogart, Jamaica, N. Y.
279,826 Electric Machines, Combined Current Indicator and Commutator Adjuster for Dynamos. R. J. Sheehy, New York, N. Y.
279,640 Electrical Conductors, Underground System of Laying. J. E. Hamilton, New York, N. Y.
279,713 Electrical Instrument Protector. M. D. Connolly, Philadelphia, Pa., and T. A. Connolly, Washington, D. C.
279,557 Electrical Switch Board Plug. E. Flint, Jr., Boston, Mass.
279,872 Galvanic Battery. T. L. Kauffer, and J. Seron, Boston, Mass.
10,344 Insulator, Electrical (re-issue). D. M. Steward, Cincinnati, Ohio.
279,517 Lamp, Electric-arc. H. Ansot, New York, N Y.
279,824 Lamp, Electric-arc. R. J. Sheehy, New York, N. Y.
279,811 Lamp, Incandescent. C. Richter, Camden, N. J.
279,839 Secondary Electric Battery. E. T. Starr, Philadelphia, Pa.
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279,712 Telegraphic and Telephonic Instruments, Protector for. M. D. Connolly, Philadelphia, Pa.
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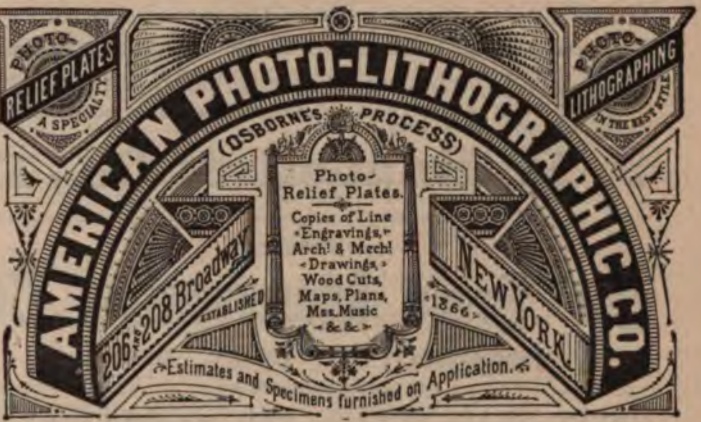

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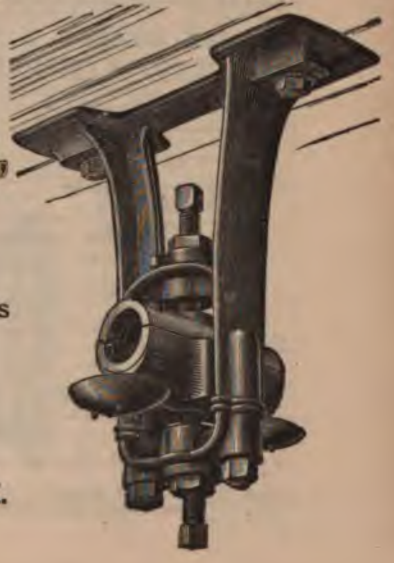

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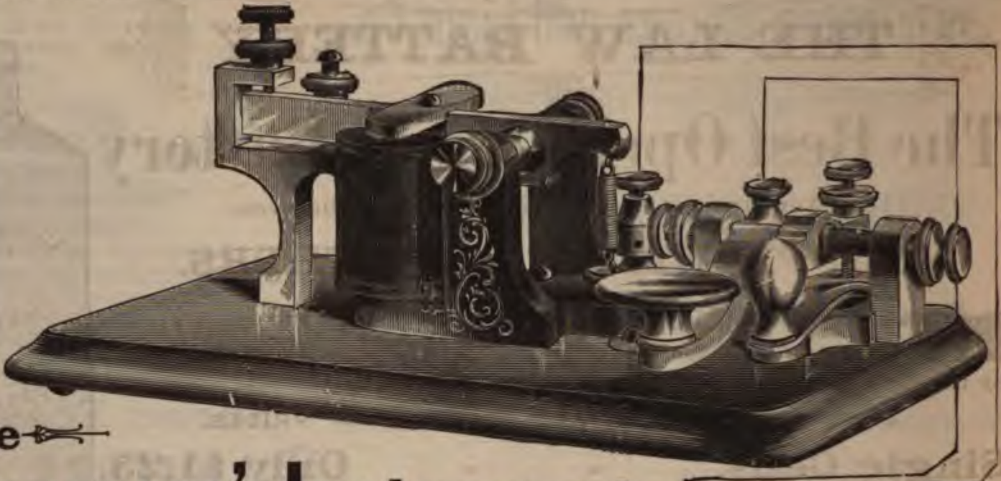

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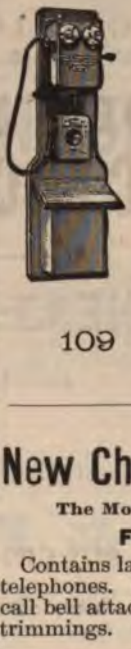

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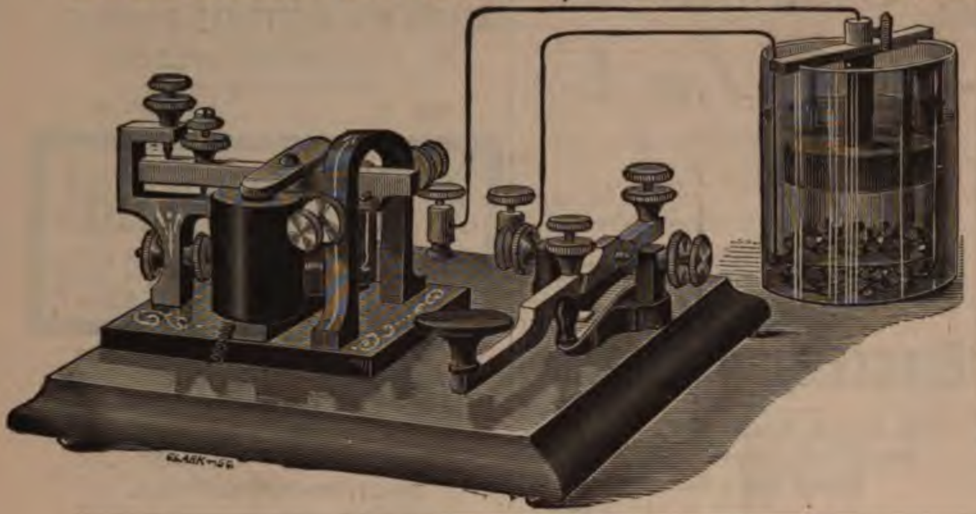

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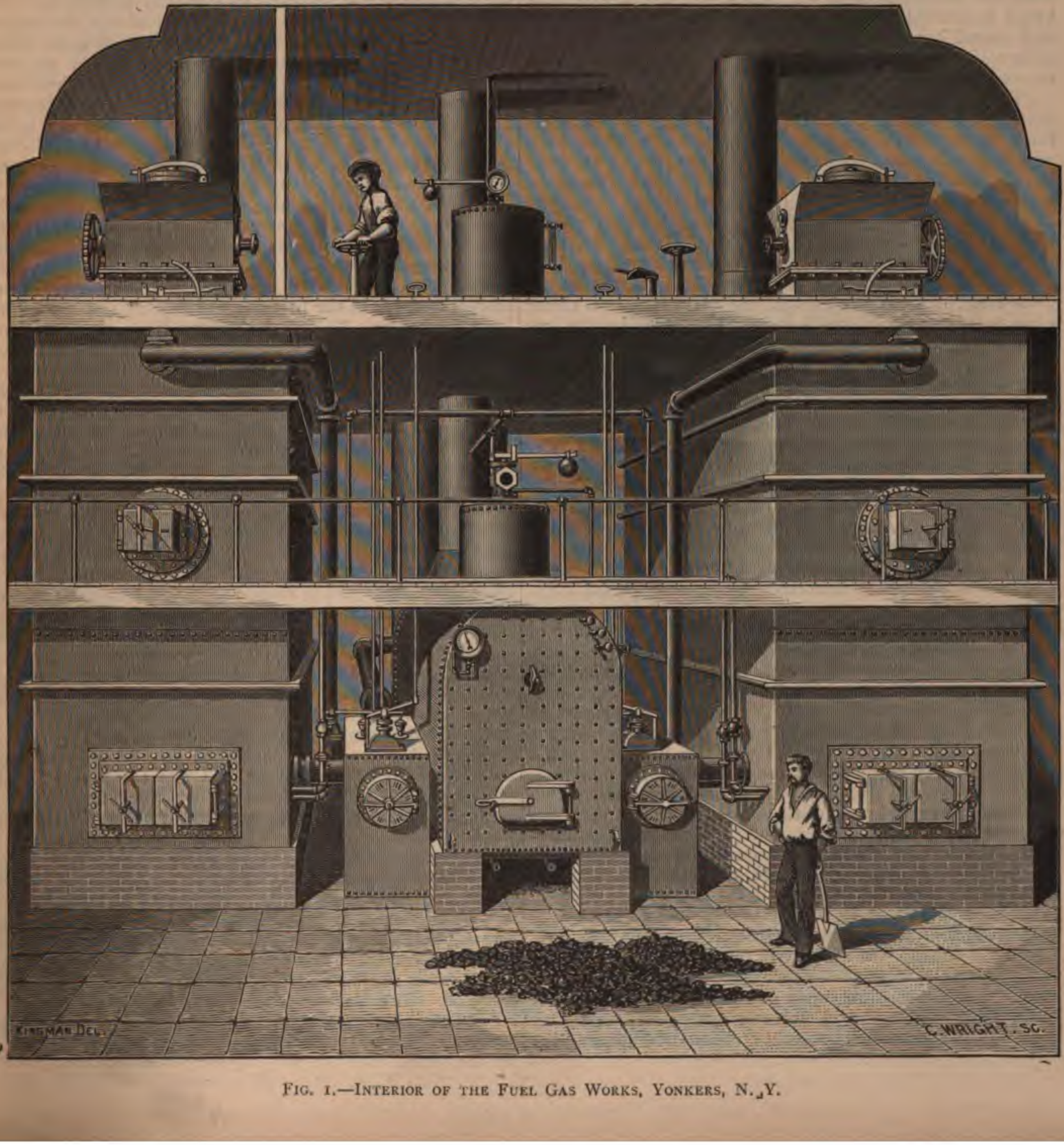
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FIG. 1.—INTERIOR OF THE FUEL GAS WORKS, YONKERS, N. Y.

First, a general remark on the chemistry of burning fuel. Every time that a fire is made from solid material, a combustible gas is produced, the burning of which gas, does the work in hand, so that stoves and ranges are both gas producers and gas consumers; and grossly defective and wasteful, at the very best. It is estimated that not over eight per cent. of the fuel consumed in them is utilized. Indeed, it is not reasonable to expect that Bridget, with her crude appliances, and ignorance of scientific principles, can make gas for the household, as well and as cheaply, as it can be manufactured in large works, expressly constructed for that purpose and operated by skilled labor. But let the pure element of heat be first prepared with all the facilities which science affords, and sent into the house the same as flour, she can then use it under like conditions of convenience and economy. It is quite as absurd in principle to deposit the coal in the cellar, to be made into gas, by the scuttle or shovel full, as it would be to store up the sheaves from the harvest field in the garret, and every time that bread is needed, thresh out grain enough for a batch, and pound it into flour. All that we require from the one scource, is the farinaceous, from the other the calorific substance.

The introduction, therefore, of any system by which the family fuel can be placed upon the same footing as the family flour, and the worthless residuum, with all its evils and abominations banished from our dwellings, must establish an epoch in civilization. Nor is it only in our domestic economies that the crude fuel plays its role of vice and extravagance. In the manufacturing department its infirmities are still more conspicuous. There is scarcely a mechanical operation requiring the combustion of coal, in which the artisan is not hampered on account of its gross and unmanageable nature. At every turn he is called upon to solve a double problem—the best mode for the production, and the best mode for the application of his heat; oftentimes he is compelled to consume a pound of coal, when the gas, which an ounce of it will make, would better do the work.

The first care of the *Yonkers Fuel Gas Company*, in the pursuit of its undertaking, was to seek out a process by which a gas could be made, that would fulfill all the conditions required; it must be pure, of high calorific power, safe to handle, easy of delivery, and above all, cheap of production. After much investigation, these requisites were found in what is known as the "Strong System," which consists in decomposing superheated steam in association with incandescent carbon, within an enclosed furnace or retort.

It is well-known that water, although an extinguisher of fire, is composed of two gaseous ingredients, one of which, hydrogen, is the most combustible of all the gases, and the other, oxygen, is necessary to the support of all combustion. By adding a third factor, carbon, in the proper proportion and under the proper conditions, the product becomes a combustible gas, non-luminous, but of the highest calorific value. A cheap mode of converting this costless and universal element into a fuel, was the philosophers' stone, most assiduously sought by scientists ever since the constitution of water was known. No results from these attempts, however, were realized which would entitle water gas, as this product is now commonly called, to a place amongst the commercial industries, until within the last few years, when, carbureted to impart to it luminosity, it has come into extensive use as an illuminating gas.

Of all the modern inventions for its manufacture, the Strong process is unquestionably the most scientific and exhaustive. Proceeding upon the economic principle of interior combustion throughout, employing an apparatus of the simplest and most substantial construction, utilizing the natural laws and forces, the maximum results are obtained with the minimum means.

The diagram, Fig. 2, represents the gas generator, of which there are two in the company's works at Yonkers, each having the capacity of producing 250,000 cubic feet of gas per day, requiring but the labor of two men and a boy. The apparatus is 5½ feet wide, 14½ feet long, and 14 feet in height. It consists of an iron shell lined with fire brick. The interior is divided into three equal compartments, by two fire brick partition walls. The first compartment is the furnace in which the coal is consumed; the other two are laid up loosely with fire brick, the interspaces being for the passage of the products of combustion, and serve as superheaters for the steam. An iron hopper is placed over the furnace from which coal dust is discharged into it at the proper intervals. The operation of making gas is also very simple; a blast of air is applied under the hydraulic grate bars, to the coal burning in the furnace the first products of combustion (Siemens' gas) are met with another blast as they pass into the top of the first superheating chamber; a secondary combustion of great intensity occurs in that chamber, a large portion of the heat being absorbed by the fire brick; at the bottom a third blast is introduced, which consumes any combustible elements remaining over, the heat being stored up in the fire brick, as before, and the waste products finally make their exit through a flue at the top, at a comparatively low temperature. After the generator has been sufficiently heated to make gas, which in practice is about one hour from the starting of the fire, the gas is made in runs occupying ten minutes, that is, five minutes for superheating and decomposing the steam, and five minutes for again blowing up the heats. The blasts being shut off, and the escape valve closed, steam from the boiler is admitted at the top of the last superheater. Taking the reverse direction of the products of combustion, it passes down through that chamber, up through the first, and over into the furnace, where it comes in contact with the coal dust showered down from the hopper. Having become superheated to the point of dissociation by its passage through the mass of heated fire brick, the steam instantly decomposes; the oxygen contained in it, having a greater affinity for the carbon of the burning coal dust, than for the hydrogen with which it was in association, combines with the carbon, forming carbonic oxide, and liberating the hydrogen; the resulting gaseous product passes down through the bed of incandescent coal in the furnace, whereby any carbonic acid remaining in it takes up another part of carbon, and also becomes carbonic oxide; the gas is then made; it is cooled, freed from ash, or other mechanical impurities, by washing, and is sent into the holder for distribution; no other purification is required. The sulphur is almost entirely eliminated by chemical action within the furnace, and goes off with the ash; the gas is evolved with great rapidity, due probably to the instantaneous decomposition of the coal dust. From 2,000 to 3,000 cubic feet are made at each run; 70,000 cubic feet are obtained from one ton of coal, one third of which is coal dust, and improvements in the apparatus are being made, which it is expected will still farther increase the yield.

The most striking advantages of the Strong process are: 1st, The extreme rapidity with which the gases are generated in large volumes; 2d, The variety of materials which may be employed, and their low cost, as coal or coke in the furnace, coal dust or peat in the hopper, or a liquid carbon; 3d, The remarkable purity of the product, and its high calorific power; 4th, The economy of apparatus and labor involved. New features of the process will be a gas boiler, for generating the steam, and the gas engine for driving the blower.

Analyses, by Dr. Gideon E. Moore, prove that the unpurified gas contains less sulphur than is generally found in the purified illuminating gas. The percentage of non-combustible constituents is also extremely small, as will be seen by the following table of composition :

Non-Combustible.		*Combustible.*	
Oxygen, - -	0.77	Light Carbureted Hydrogen,	4.11
Carbonic Acid, -	2.05	Carbonic Oxide, - -	35.08
Nitrogen, - -	4.43	Hydrogen, - - -	52.76

This product will be recognized as representing the best mixture for calorific purposes known to science.

According to Dr. Moore, the specific gravity of this gas is 0.5408, air being unity ; 1,000 cubic feet weighs 41.16 lbs., possessing the theoretical heating effect of 362,113 units, of which 90 per cent. would be realized in practice. One cubic foot requires for its perfect combustion, 2.47 cubic feet of air. A pound of coal requires from 150 to 200 cubic feet of air.

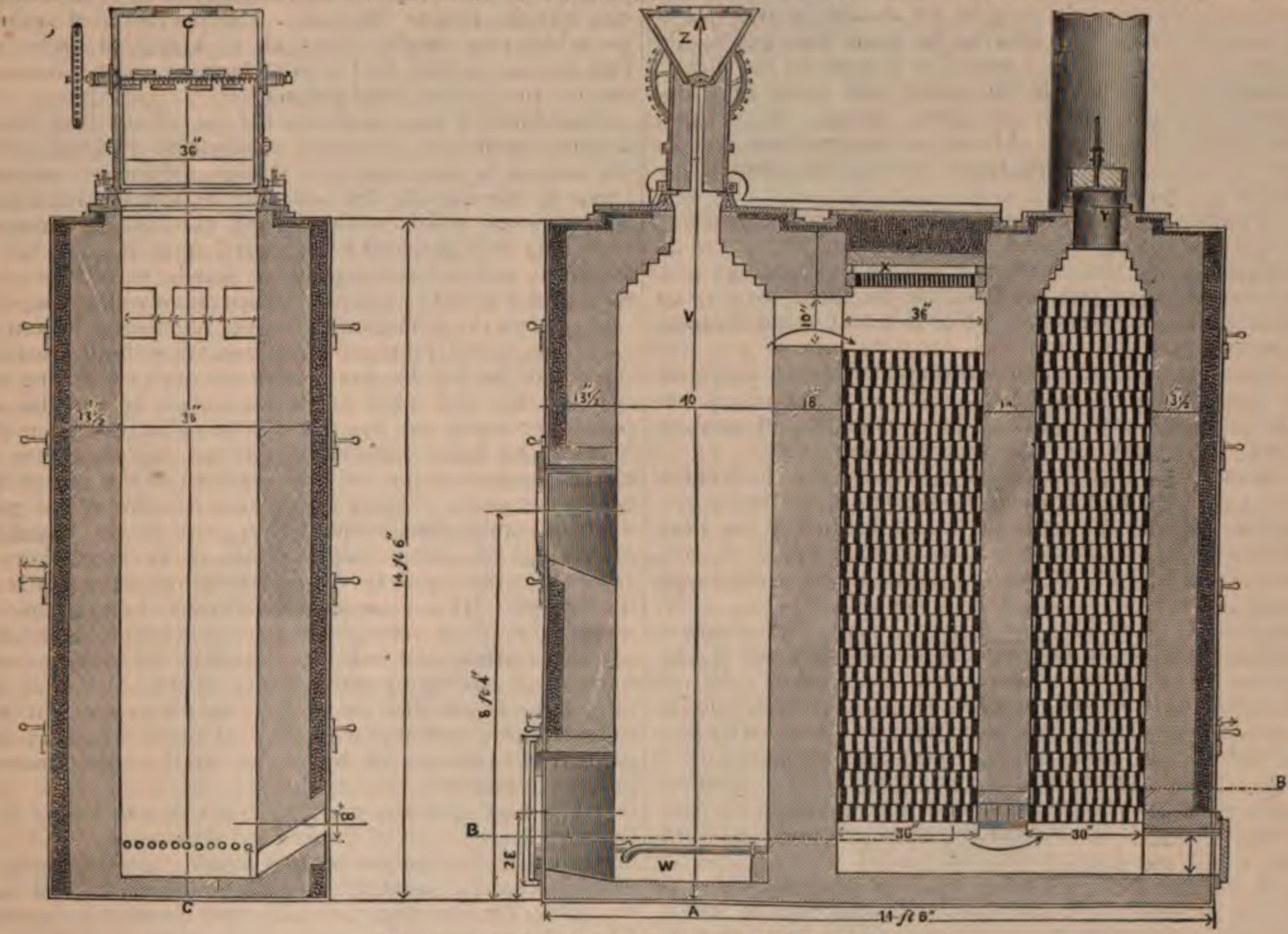

FIG. 2.—INTERIOR PLAN OF STRONG GAS GENERATOR.

Vertical Section at AA.

Vertical Section at CC.

V, Point of contact of steam and coal dust.
X, Perforated tiling.
Y, Escape and steam valves.
W, Hydraulic grate bars.
Z, Hopper for coal dust.

We, therefore, have a reliable basis of comparison between the practical heating value of this gas and that of the coal consumed in making it. One ton (2240 lbs.) of anthracite coal possesses the theoretical heating power of 29,120,000 units, of which, in practice, under ordinary conditions and by continuous use, as in the generation of steam, only 50 per cent, 14,560,000 units would be realized. The 70,000 cubic feet of gas, made from a ton of coal, represent 25,347,910 heat units, which, in practice and under equal conditions as to radiation and continuous use, will produce the heating effect of 22,813,119 units, there being a difference of 8,253,119 units, or 34 per cent. in favor of the gas.

In heating a room with coal, 100 lbs. would require at least 15,000 cubic feet of air for its combustion, and would develop 650,000 available heat units ; under the same conditions, 2,000 cubic feet of gas made from 64 lbs of coal, would develop the same amount of available heat units, and would require but 5,000 cubic feet of air for its perfect combustion; consequently, the net result of heating by gas would be three times as great as that of the coal, and, putting the coal at $5.00 per ton, and the gas at 50 cents per 1,000, would make the difference of cost 35 cents in favor of the coal, which would be more than counterbalanced by the collateral advantages of the gas.

One and three-quarters cubic feet of this gas, per volume, possesses the heating power of one foot of illuminating gas, but its superior flame intensity, which is 900 degrees higher, fits it for a class of work, entirely beyond the capacity of the latter gas.

This gas is sold in Yonkers at 50 cents per 1,000 cubic feet. The company has about four miles of street mains, and fifty consumers. It is used for the following purposes :

In hotels, restaurants, and private families, for cooking ; in hat, carpet and other factories, for heating irons, glue, &c.; by jewelers and tinners, for soldering ; in foundries, for baking cores; in bakeries, for baking purposes generally; for drying ; in a wheelwright shop, for setting tires ; by druggists, for preparing medicines ; by barbers, for heating water ; for warming stores, offices, and dwelling apartments.

In every case where it has been used, it has given perfect satisfaction, and the demand for it is steadily increasing. For many uses, it proves to be much less expensive than the first cost of coal; and for nearly all the heating purposes, at 50 cents per 1,000, with proper appliances for burning it, the expense will not exceed that attending solid fuel. Although it has been in promiscuous public use for nearly three years, not the slightest accident has been caused by it. Its character, therefore, as a safe, cheap and efficient heating agent may be considered as established.

For cooking, it is simply superb. It does not blacken, nor even tarnish the brightest utensils, and meats broiled by its flame are not impregnated with odors or charged with hydro-carbon deposits, as in the case of illuminating gas.

The company has perfected systems of warming entire houses, by means of steam and hot air, generated by the gas, which will be put in extensive operation the coming winter.

Exhaustive experiments have also been made with it in melting glass, reducing ores, puddling, making wrought iron and steel directly from the ore, welding, and in many other metallurgical operations, for all of which purposes it has been found to be admirably adapted. But one of the most important applications thus far made of this gas, and which will be of especial interest to the readers of THE ELECTRICIAN, is for motive purposes in the gas engine. The utmost attention has been devoted to the department of power, and the success obtained is so wonderful as to seem almost incredible.

After long experimenting, an engine has been produced that possesses all the requisites of a perfect gas motor. It is the invention of L. C. Parker, Esq., formerly of Robinson, Kansas. Patented (by re-issue) February 20, 1883.

Some of the principal features of this engine, and which distinguish it from all others, are the following: The valve, which admits the explosive mixture of gas and air into the cylinder, is placed within the head of the cylinder, and is kept in its seat by the internal pressure. It is actuated by a cam, and only moves when it is not under pressure. It consists of a simple plate of cast iron, about the size of a man's hand, having two ports, one for gas, the other for air. At the time of explosion, this valve is stationary, and the greater the force of the explosion, the more firmly it is held in its position, and the tighter it closes the ports. The friction incident to its operation is, obviously, almost null.

Another novel feature of the engine is the auxiliary chamber, of which there may be one or several, located on the cylinder, and communicating with its bore by ports, which are covered and uncovered by the piston in its travel. As the explosive mixture is admitted into the cylinder, through the valve above described, which occurs when the piston has completed its outward stroke, a portion of the mixture fills the auxiliary chamber, or chambers, the return stroke of the piston compresses the charge, separating the portion in the auxiliary chamber, or chambers, from that in the body of the cylinder, by passing over and closing the ports between them. The portion of the mixture remaining in the head of the cylinder, and which may be termed the firing charge, is first exploded; the piston moves on a little and uncovers the ports of the auxiliary chamber, or chambers, when the power charge contained therein is also ignited by the flame produced by the combustion of the first, or firing charge. Thus a sustained impulse is imparted to the piston throughout its entire stroke, by a succession of explosions, and a continuous power is developed as uniform and efficient as that of steam; the auxiliary explosions occurring when the crank has its greatest leverage. A coil of iron or copper is also attached to the head of, and moves with, the piston. This attachment serves many important purposes. It absorbs, and thus retains, within the bore of the cylinder, a large proportion of the heat resulting from the explosions, which would otherwise go into its walls, and have a tendency to overheat it; very little water, consequently, is required in the water jacket. As the coil is at its remotest point from the head of the cylinder at the time of charging, it does not in any way obstruct the entry of the charge, but as soon as the inlet ports are closed, it is forced back, highly heated as it always is, through the midst of the charge, thoroughly mixing, heating and compressing it, and rendering the explosions effective to the highest degree. But for this coil, the compression in the auxiliary chamber, or chambers, would be less than that of the firing charge. Its action, however, is to displace from the bore of the cylinder, and transfer through the lateral ports, a much larger portion of the mixture than would otherwise enter, as the piston exercises the compression. Thus the principal part of the power developed is due to the subsequent explosion, or explosions. This coil also greatly aids in expelling the products of combustion, and improves the exhaust.

Another and unique device is the igniter; the primary or firing charge is ignited by electricity; the current for this purpose is generated by a miniature dynamo, forming a part of the engine, and operated from the crank-shaft; the conducting wires are carried into the cylinder through insulators; at the proper time for ignition, the circuit is broken by appropriate mechanism, instantly producing in the midst of the firing charge a spark about as large as the head of a pin, but intensely vivid and powerful. Besides the economical advantages of this mode of ignition over that of the gas jet, which moreover is liable to be obstructed or blown out, the spark is always certain to produce an explosion, and is an absolute safeguard against fire; not even a match being required to start the engine; a turn of the fly wheel produces sufficient current to set it in motion; further, it secures a uniform speed of the engine at all times, because it admits of an explosion at every power stroke of the piston, the engine being governed by increasing or diminishing the quantity of gas in the mixture, which is most effective when composed of one part of fuel gas to six parts of air. This characteristic of the engine especially adapts it to electric lighting, in which use the igniting spark may also be taken by a shunt, from the large dynamo; the jet igniting plan requires the charge to be cut off entirely for one or several power strokes, in order to check the speed if the work is reduced, this necessarily causes fluctuation of the power.

The following drawing of the interior plan of Parker Gas Engine will more clearly illustrate the invention.

One of these engines has been running in the company's works for several months; the diameter of the cylinder is 5¾ inches; stroke of piston, 11 inches; speed, 250 revolutions per minute; fuel gas consumed, 240 cubic feet per hour; it runs 28 Maxim incandescent lamps up to standard, and has a considerable surplus of power; the lights are perfectly steady, and are pronounced by experts as fine as any they have ever seen. The following cut, Fig. 4, represents the engine.

The inventor of this remarkable machine, seems to have had in view throughout, simplicity and economy of construction; utilization of all the forces; saving of friction. The comparative tests thus far made, warrant his claim that it will produce from 15 to 20 per cent. more net power, from the same amount of gas, than any other gas motor in use. Engines of 25 horse-power, having a double cylinder upon one bed plate, with the pistons connected by a cross-head, and having one rod and crank shaft, are now being built expressly for running dynamos; this mode of construction will ensure a power stroke at every revolution of the crank, and will greatly increase the efficiency and economy of the machine. They will also be made down to a man-power for running sewing machines, and other domestic apparatus. The tests also establish that fuel gas is the natural element for the gas engine; that although it can be successfully operated with ordinary illuminating gas, it runs much better with the fuel gas, and for the following reasons:

1st, The large proportion of hydrogen which it contains (52 per cent.), gives it great avidity for combustion, insuring prompt and uniform ignition, under a high rate of speed; 2d, Containing no hydro-carbons, there is no deposit to clog the pipes, valves and cylinder; the inside never requires cleaning; 3d, The explosions are not as violent, and do not over-heat or over-strain the engine; 4th, Its much greater economy.

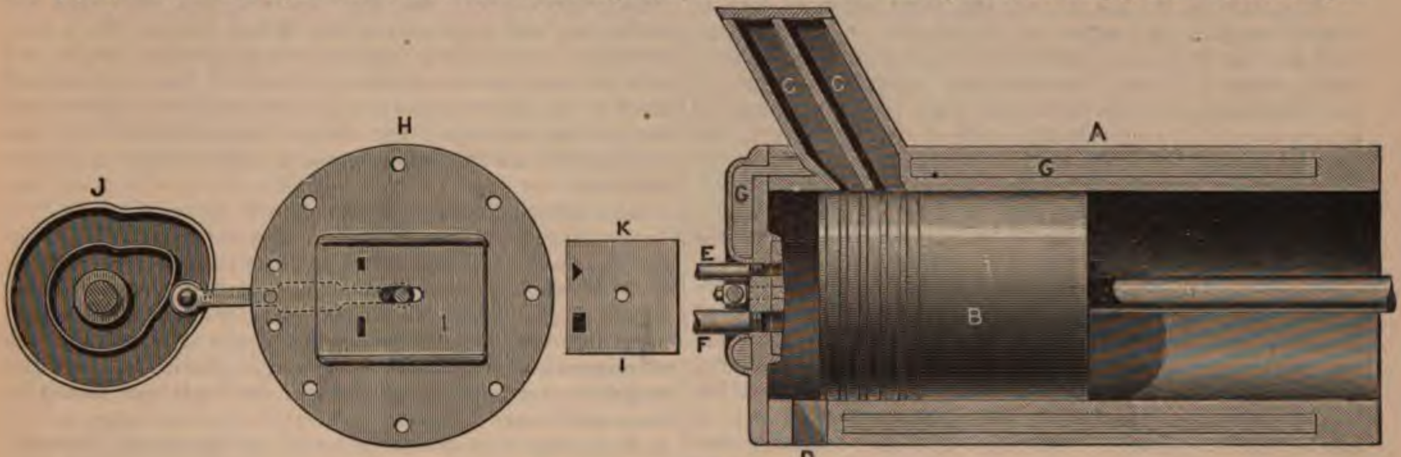

FIG. 3.—INTERIOR PLAN OF PARKER GAS ENGINE.

A, Cylinder.
B, Piston.
C, C, Auxiliary chamber.
D, Exhaust port.
E, Gas port.
F, Air port.
G, Water space.
H, Cylinder head.
I, Valve and seat.
J, Cam wheel.
K, Valve.

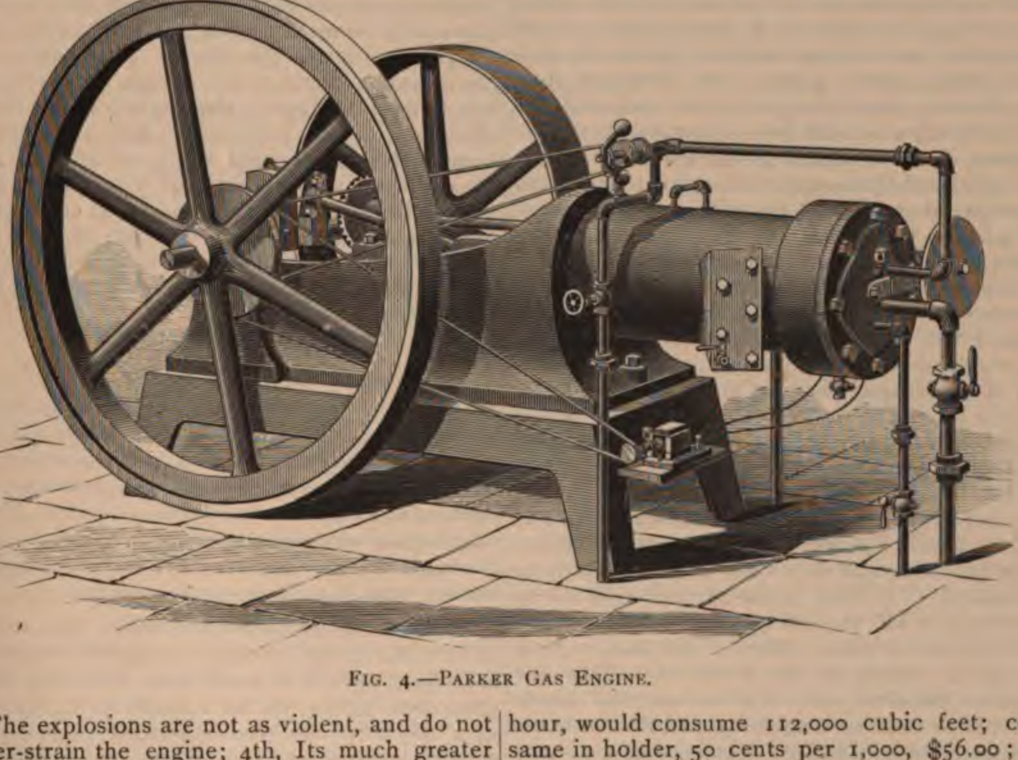

FIG. 4.—PARKER GAS ENGINE.

In the Parker engine of large size, it will be perfectly feasible to obtain one horse-power per hour for every 31¼ cubic feet of this fuel gas; this would amount to 2,240 horse-power per hour, from 70,000 cubic feet, the product of a ton of coal; equivalent to a horse-power per pound of coal, and is a result far exceeding that which can be realized in the best compound marine steam engine. Assuming that 10 incandescent lights of 16 candles each, can be gotten from each horse-power (which is already attained), we will have 22,400 from 70,000 cubic feet of gas, which at the cost of manufacture, 10 cents per 1,000 cubic feet would be $7.00.

Contrast with this, the most favorable statement that lighting by gas will admit of; the same number of jets 22,400, of like candle power, burning 5 cubic feet each per hour, would consume 112,000 cubic feet; cost of putting same in holder, 50 cents per 1,000, $56.00; difference in favor of the electric light, $49.00. And this is giving the gas light companies the benefit of the same cost of plant, when theirs is much more expensive.

The reason of this great disparity is quite apparent; it is heat that produces the light in both cases; the heat contained in the fuel gas, is by mechanical force instantly converted into the pure element of light; all the combustion occurs in the cylinder of the engine; the product is power; this power applied to the dynamo induces the electric current, which being suddenly arrested by the non-conductibility of the carbon filament within the lamp, is transformed into light. The only loss of heat energy in the entire evolution, is that caused by radiation and friction, which is comparatively small. It is, therefore, a strictly scientific and logical method of obtaining artificial illumination—incandescence without combustion.

The light of the gas jet, on the other hand, is due to minute particles of carbon or illuminants in combination with the non-luminous, combustible base called the diluent, which, when it burns, consumes and renders incandescent the illuminants, and the amount of light resulting is greater or less according to the heating power of the diluent, and the richness of the illuminants. The heat evolved by the combustion is entirely lost, sacrificed. Light only is wanted, but heat must also be taken and paid for in the account, and oftentimes people prefer to be incommoded by the absence of the light, rather than by the presence of the heat. The sum total of this waste is enormous, and abundantly explains the discrepancy shown to exist. The number of available heat units in the 112,000 cubic feet of illuminating gas is 53,876,624, as against the 22,813,119 of the fuel gas burned in the gas engine. Consequently, there is a net loss of 31,063,505 heat units, and coming from a source much more expensive. In arc lighting, reckoning one horse-power to a lamp of 2,000 candles, we would have 4,480,000 candles, equal to 280,000 gas jets, or 1,400,000 cubic feet of illuminating gas.

It may be claimed that the illuminating gas itself, could be used in the gas engine and generate as much light by electricity as it would make if consumed at the burner. This is probably so, but carbureted gas is no more fitted for the cylinder of a gas engine, than water from a mud pond is for the boiler of a steam engine; the small percentage of illuminants, about 5 per cent., although they may double the heating power, quadruple the cost; and it is contrary to the rudiments of economy to manufacture one illuminant, and use it as a means to produce another.

When it is considered that a city or village can be lighted by electricity produced at this rate by a fuel gas and power plant, occupying but a tenth part of the area of illuminating gas works of equal capacity, and without laying a foot of street main, it will be difficult to find a reason why lighting by electricity should not become universal. When it is further considered, that after the business of electric lighting is thus established, fuel gas will only have entered upon its career of usefulness; that the great fields of heating and power still remain to be exploited; that a thousand feet of it will be consumed to every one foot of illuminating gas, it seems incomprehensible that gas light companies should not perceive where their true interest and safety lie, and with one accord adopt this great improvement, which is the key not only to electric lighting, but to the whole situation. This is their true function, and they must either accept it or abandon the business. "Il faut qu'ils se soumettre où se démettre." Electricity will explode gas every time, but gas will not explode electricity once; better, it will make it, and the sooner they go to making it, the better it will be for them and for their customers; and the sooner that bitter controversy, which has been so long going on between their various factions, as to which kind of illuminating gas contains the most poison? or, as they themselves put the question before the public, whether it is more dangerous to be drowned in ten or twenty feet of water? will cease; and the whole gas world will be at peace. It would require a new order of inventive talent to cause any serious accident with the incandescent electric lamp.

This simple, dangerless, inexpensive but efficient gas motor, is automatic in all its operations; noiseless, cleanly, and even ornamental; it can be started and stopped instantly by anybody, and placed anywhere.

We have given some of the advantages of the system inaugurated by the *Yonkers Fuel Gas Company*, all the factors of which are now perfected and ready for utilization; and it promises a solution of some of the most difficult and important engineering problems of the day.

The time, probably, is not far distant when the trains of the elevated railway, and East River bridge, and even the horse cars, will be propelled and lighted by electricity, generated by means of fuel gas and the gas engine, and heated with the same universal agent. Indeed it does not require much of an effort of the imagination to see this gas manufactured at, or within the mines, and delivered into the cities on a scale that will make it almost as free as air or sunshine.

It is only a question of capital and engineering skill to construct a pipe line from the coal deposits of Carbon County, Pa., which will transfer their treasures of carbon, in the form of this gas, into the city of New York.

A line, adequate to the supply of all our domestic and manufacturing wants, could probably be built for the cost of the transportation of the coal for a single year. It could be furnished at a price so low that the city's garbage would be consumed by it.

Extravagant as this project may at first seem, it is far from being utopian; more gigantic and difficult, and we may add less beneficial, undertakings, have been accomplished. The only, the vital question is, will it pay? Let capital be satisfied on that point, and the work may be considered as already done.

As the conductors of a journal devoted to science and improvement, we feel that it is our duty to record the progress thus far made in this new direction, and to indicate the possibilities of the future. From some investigation at the various industries at Yonkers, where the above system has been introduced, the highly influential and wealthy character of its promoters, and the facts and figures furnished us in regard to it, we are led to believe that we are upon the threshold of a revolution in the physical economies, that will transcend in its consequences all those of the past, and mark a new era in the world's history. Furthermore, that the master spirits of this revolution will be these two kindred elements of power, *Fuel Gas and Electricity.*

—— SIR F. A. ABEL, F. R S., in a recent lecture at the Institution of Civil Engineers in London, on "Electricity Applied to Explosive Purposes," said: "In the United States the subject of the utilization of electricity as an exploding agent for war purposes was being actively pursued, and important improvements in exploding instruments, electric fuzes and other appliances had been made by Smith, Farmer, Hill, Striedinger, and others already mentioned, while no individual had contributed more importantly to the development of the service of submarine explosions than General Abbot, of the United States engineers."

—— AT THE SOUTHERN EXPOSITION, which will be opened August 1st, at Louisville, Ky., the main building will be lighted by 4,600 Edison incandescent lights of 16 candle power each; nine engines will furnish power to the shafting, viz: one Reynolds-Corliss, 500 h. p.; one Porter-Allen, 275 h. p.; one Harris-Corliss, 200 h. p.; one Taylor, 100 h. p; three Armington & Sons, 400 h. p.; one Westinghouse, 100 h. p.; and one Buckeye, 100 h. p.

—— OSCAR WILDE, in his recent lecture in London on "Impressions in America," said, that "the beautiful he found where the Americans had least striven for it, in their great bridges and their perfectly beautiful use of the electric light.

THE FUTURE ELECTRICAL ENGINEER.

WE take the following, on the above subject, from our English cotemporary, *The Mechanical World:*

Until the advent of the improved dynamo-electric machine, the study of electricity was practically confined to the physical laboratory. Telegraphy aside, there was little commercial application of the agent; and it has arisen that now that the necessity has arrived for carrying into practical operation the inventions and elaborations of scientists, the right men to do the work are wanting. For the most part electricity has to compete with agents already in possession of the field under the control of men who have had a long practical training and experience, and know exactly what to do and how to do it to the best advantage. It is, therefore, important that those who essay competition should be able to devote a similar knowledge and experience to the business before anything resembling the fullest possible success can be achieved. Lacking these qualifications there must be a loss of economy, a liability to avoidable accidents, and an unpreparedness for every emergency that will be fatal to the system.

Electric lighting, or speaking more broadly electric engineering (as distinguished from telegraph engineering), has sprung into existence so rapidly and has extended so widely, that the directors of the numerous companies have been obliged to secure the services of all manner of men. It has been a sufficient qualification, in many instances, if the candidate for employment could prove that he had been in the employment of the post-office telegraph department, the cable companies, or some of the extinguished telegraph companies, in any capacity whatever. Now we hold, and shall shortly endeavor to show, that estimable as these men may be, and competent for the work they have abandoned, yet, so far as regards nine-tenths of them, they are the most unsuitable men that could possibly be selected for the work. A better class of recruits are those who have distinguished themselves in technical and scientific examinations, and therefore produce evidence of training and ability, but being young they lack experience. The experience, however, even if they were grey-beards, could not have been acquired, so that the only practical objection is their youth. Others who have rushed in with the best intentions, have been trained as mechanical engineers, and these men, as a rule, fare more successfully than the rest. The ranks beyond those specified are composed of all sorts and conditions of men who have assurance enough, and influence to obtain an appointment, but whose total want of all the necessary qualifications is lamentable. We do not blame the directors, for with them it has generally been "Hobson's choice," nor do we blame the army under them, for it is possibly as good a one as could be obtained at present, save and except the company of telegraphists. There is, we find, in connection with nearly all the companies, an electrician and an engineer. This amounts to some such arrangement as would exist in a gas company, if instead of an engineer running the works on his individual authority, there should be a chemist and a mechanic, whose duties and responsibilities would continually overlap each other. Obviously the engineer should also be an electrician, and have the sole working control —in other words, the manager of a successful concern must be an electrical engineer, just as in an engineering establishment the manager must be a mechanical engineer. Thus the divorce of scientific from technical knowledge, implied by the existing arrangements, cannot be effected without imperiling the future.

The electrical engineer of the future must have a sound practical training in the schools and shops, and more especially in the latter. He must be well grounded in the physical sciences and in mechanics, for he will have under his control complicated engines and machinery, and in their installation will have to be prepared for unexpected contingencies. He must be able to select the best engines and boilers for his purpose; to put them down, and design the best means for driving his machines; be prepared for break downs, with the best means for preventing and remedying them without calling in the advice of his brother, the mechanical engineer. In hydrostatics and pneumatics, because of the analogies existing between these and electricity and magnetism. In sound, light, and heat, for a similar reason. In electricity and magnetism, in order that he may be acquainted with the basic theory of his profession, whatever it may happen to be at the moment. Besides all this, he must be a fair mathematician, and have a little more than a smattering of chemical knowledge.

The existing mechanical engineer, of the modern type, undoubtedly possesses the greater number of the qualifications we have indicated, and is therefore, for the present, the best man for the post, and the future electrical engineer will be essentially a mechanical engineer, with one or two additional qualifications. We have, in the course of our varied duties, had to inspect many electrical installations, and have repeatedly been impressed with the wide difference between them. In a few, a very few, instances there existed prominent evidence of special knowledge and ability. The boilers were of the best construction, and of high efficiency, the engines using the steam economically, and having a highly sensitive governor operating a cut-off valve, the belting free from lap joints and cover pieces, the machine carefully insulated, and in a perfectly dry position, the leading wires, for the most part invisible, but where obvious, carefully protected and insulated—everything about the place clean and orderly, an inspection of the brushes and commutator showing no undue friction or sparking. On the other hand, we have had evidence before us of the grossest and most culpable ignorance in installations, where any boiler and engine that could be obtained were put down, the only condition being cheapness; the engine with an old fashioned pendulum governor and single slide valve, greasy, rusty, and rheumatic, knocking at every joint, and leaking steam till the atmosphere of the room was saturated; old style leather belts, clumsily laced, with as many joints as could conveniently be got in the length, the commutators ploughed into deep grooves with a little heap of copper dust and oil below it, the brushes sparking as if the efficiency of the machine was denoted by the brilliancy of the local fireworks, the leading wires in graceless festoons, and in many places bare of insulation, and having simply looped and twisted joints; while the circuits and lamps were clumsily arranged and maintained with the apparent idea that it was desirable to get "earth" both to the wires and on and in the lamps. In every case we have endeavored to obtain the qualifications of the party responsible for the installation, and almost without exception we have found that the first cited were under the control of men who had obtained their training as mechanical engineers, while the other examples were in charge of men who had been plumbers, joiners, linesmen, stokers, laborers, warehousemen, auctioneers, clerks, or electricians.

For electric lighting and transmission of power, as we have attempted to show, the conditions are so different from those of any previous application that a new set of men is indispensable. To employ men who have everything to learn, and to forget all they know, as has been too frequently the case, is simply to court failure and disaster. The sooner the directors of the companies learn this practical lesson the better it will be for their shareholders, their customers, and the public.

—— HERR BRUNNER, the superintendent of the Austrian telegraphs, recently delivered a lecture on dynamo-electric machines, in which he expressed his deliberate opinion that the entire science of engineering is being revolutionized. These machines, he said, not only convert the power of a rotating motion into electricity, but they are able also to reconvert electricity into working energy As the most perfect solution of this problem the lecturer spoke of the machine put up at Munich by Marcel Deprez, which conveyed the power, produced by a steam engine at Miesbach, to Munich, a distance of 35 miles, by means of an ordinary iron telegraph wire. On this subject Herr Brunner spoke in the following words :—"It would be difficult to over-rate the importance of this invention. By it coal is, or will be, superseded. In future it will be possible to turn the power of waterfalls to account from the very source, whilst at this moment these streams run away unused. Every drop of them may be gathered up in turbines, which set dynamo-electrical machines in motion. These in their turn, carry the accumulated energy, *vid* a telegraphic wire, into a factory, where it is turned to account for working the main shaft or lighting the work rooms. Lastly, there will be nothing out of the way in turning electric energy to account for domestic uses, such as getting upstairs, working a sewing machine, washing, ironing, &c., nay, even a piano might be played by electricity."

THE ELECTRICIAN.

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NOTICE.

Part III, on "The A, B, C, of Electricity," by Lieut. B. A. Fiske, U. S. N., will appear in our next issue.

THE THEORETICAL AND THE PRACTICAL ELECTRICIAN.

ONE of the most curious phases of the electrical situation is the division of electricians into two classes, the theoretical and the practical. That such a division has, in fact, taken place, can be found by listening to the conversation of any group of electricians, or by following the discussions in the technical papers; for the terms "theoretical" and "practical," as applied to men, will be found to constantly occur. As a rule, it will be noticed that the word "practical," is used as one of praise, and the word "theoretical," as one of depreciation; the former being used as synonymous with "efficient" and "reliable," the latter as synonymous with "visionary" and "unreliable." It will also be noticed that every electrician desires to be designated as a practical man, and that, even if he is well acquainted with the fundamental principles underlying all the practical applications of electricity, and even if he applies them daily in his inventions, his writings or his experiments, he yet seeks to conceal this fact, or, at least, is careful not to intrude it; and endeavors to give the impression that all of his work is eminently and purely practical.

That such a state of things should exist, will seem very natural to one who considers the causes which have operated to develop the practical applications of electricity so rapidly and so successfully. For, while the physical phenomena underlying the action of dynamo machines and motors, have been understood by scientific men for many years, yet these scientific men have done little to make their knowledge of much real benefit to mankind. In almost any book on physics, written years ago, there will be found complete and clear explanations of the development of electromotive force in conductors, and the quantitative laws controlling it—a subject very little understood, even now, by many intelligent practical electricians. The action even of motors was well understood upon all points except the useful ones, and scientists made very refined measurements of the forces used and the work expended and returned in converting electrical into mechanical energy, and *vice versa*. The electric light, also, was used in laboratories, both in the arc and the incandescent forms—and yet it was by practical men that the application of the dynamo to the electric light was actually made.

This certainly seems to indicate the inaptitude of the purely theoretical mind to grapple with practical applications; and, on the other hand, the well known ignorance of many successful inventors seems to indicate both the inaptitude of the purely practical mind to deal with theoretical questions, and the lack of any necessity for so doing.

In very many cases, it cannot be doubted, a disposition to go into abstruse calculations is, not an advantage to an electrician, but a positive disadvantage, because the practical ends to be secured are apt to be forgotten in the maze of speculations in which the mind becomes involved. It is a well-known fact that the best navigators of ships at sea are often very inferior mathematicians, and that mathematicians of high scientific attainments frequently do very poor work in navigating. The reason for this is sometimes difficult to grasp; but it will become plain, if one notes how easily a man may, in carrying out his calculations to a high degree of refinement, become so absorbed in the intellectual effort, as to become careless in the most simple parts of the calculations where greater quantities are involved, and so make a mistake in simple addition, which will affect the accuracy of the result far more than the calculus with which he was endeavoring to make it needlessly exact.

But, on the other hand, it has been found that it is best for navigators to possess a thorough knowledge of the science of navigation, for the reason that circumstances often arise under which it becomes impossible to work by "rule of thumb," and it is found necessary to reason from first principles. In the same way, it is coming to be believed, it is best for electricians, especially those having the control of large interests, to be—practical men, of course—but, to a certain extent, scientific men, too. The gradual change that has come over the periodicals devoted to electricity is an indication of this; for, while a few years ago, the matter contained in them was, from a scientific point of view, of the most elementary kind, we now find in them work from the hands and brains of some of the ablest scientists of the age; and it is not an exaggeration to say that the matter found in their pages is of a higher intellectual order than that of almost any other class of periodical. The fact that their circulation is constantly increasing, instead of diminishing, shows that the scientific method is regarded with favor by their readers; and the numerous letters received from these readers, containing original ideas and calculations, shows that they themselves are coming to regard the subject from a scientific point of view.

It is believed, then, that the division between theoretical and practical electricians is daily becoming more and more narrow, and it is to be hoped by all well wishers of electricity, that it will become very narrow indeed. As the practical requirements of electrical systems become more apparent, it is to be hoped that scientific men will turn their keen and well stored minds from the contemplation of abstruse questions, and will give the world the benefit of the knowledge they possess; and it is also to be hoped that, as the dependence of all electrical applications upon scientific principles becomes more apparent, practical men will seek to reinforce their foresight, ingenuity and skill with a sound and clear comprehension of the principles of which their work is the application.

It may be stated that electrical science has now passed the qualitative stage, and reached the quantitative. A very few years ago, an inventor's fortune would be made, if he could devise any slightly new combination whereby he could produce an operative electric light or dynamo; while now, it is not only necessary for him to do this, but also to prove that his apparatus accomplishes more work per pound of fuel, or else does the same work more advantageously, than any other. A few years ago, it was not considered a matter of much importance to provide for the distribution of electricity to consumers after it had been generated; while now it is essential to calculate to a nicety the loss of heat in the mains, and to proportion the amount of copper in the conductors to the requisite strength of current. Economy is the great test of every enterprise in this commercial age; and it can be given almost as an axiom, that wherever in great matters the question of economy must be considered, there we shall find an absolute necessity for exact and careful calculation, and therefore, a pre-existing necessity for a sound and clear comprehension of the principles upon which electrical science rests, and the quantitative laws controlling them.

It is believed, then, that the enlightened electrician who desires to attain the foremost rank in his profession, will not devote himself wholly to the scientific and theoretical branch of the subject, nor yet wholly to the practical branch, but will seek to combine the two in the most *scientific* and *practical* manner. Remembering that whatever is really true in theory must be absolutely true in practice also, or else the theory is somewhere wrong, he will endeavor to gain from scientific books a clear comprehension of principles, and will try by careful observation in daily life to see the best modes of applying them. Above all, let him not despise the purely scientific man, because he is not able to practically apply his knowledge, remembering that, after all, the present development of electrical science is due primarily to men like Faraday, who worked in the mines of physical science, and left to others the task of bringing their discoveries out into the outside world of practical life, and fitting them to do good to men. Expectant of no reward but the intellectual pleasure of grappling with the mysteries of the universe, such men toiled (and are still toiling) often in obscurity and poverty, while others reap the rewards of wealth and fame that fall to the successful inventor.

THE TELEGRAPHERS' STRIKE.

THE strike of telegraphers is the most important event of the kind in the electrical history of this country; it also presents new phases of the relations between capital and labor. It has the great advantage over every other strike of making people think. business men suffer serious losses; the whole community, in fact, have begun to see that there is after all a great solidarity in the life of to-day, that the interests of all classes are indissolubly bound together—we cannot ignore the meaning of the words—commonwealth and commonweal.

The fact that most important public interests, that the very life of the trade and commerce of this vast country, are now practically in the hands and at the mercy of a few individuals, is beginning to attract serious consideration, not unmingled with alarm. That such a false condition of affairs, can long continue without provoking great evils, we do not believe. With all our progress in material wealth, and with our better distribution of life comforts, it must be admitted that the immense undeveloped resources of the country constitute the chief factor in our prosperity.

The strike of the telegraphers has called forth some strong expressions against the telegraph companies. Let us analyze the reason for this expression, and we find that they are practically these: Fifty-two millions of people will not patiently bear that a few individuals possess all the means of the rapid transmission of thought, as seen in the telegraph system, and of locomotion, as in the great railroad companies. If such should be the case, then the American people become the helots of the civilized world. Thought stopped, the highways closed, and bread "cornered" for the benefit of a few unnaturally immense rich men, are prospects ahead that make some ask, whether we must not adopt the nationalization of our telegraphs and railways. Our post-office system—with the exception of the star route frauds—has worked satisfactorily, and there is little doubt now, but that a movement will be made to add the telegraph system to it, as has been done in England. It is true that our political system is corrupt, but a little reflection will show that the hard worked *employés* of the post-office and telegraph have little time for lobbying and scheming.

The Western Union has shown great enterprise, but it seems to us, that it has ignored its responsibilities to the public in this question, and that it has disregarded its duties towards its *employés*—men whom it cannot replace, and without whom it cannot exist. A careful investigation of the grievances of their *employés* should have been made. Could these managers really answer that they could find 15,000 intelligent and efficient operators to supply the places of the 15,000 tried men they discharged? If so, then telegraphing is at best a poor trade, and young men might find better occupation. In any case, however, the future of the telegrapher is not very promising; there is no prospect of advancement beyond a certain point; he can never hope to become his "own boss," and set up business on his own account. The work requires great attention; brain and ear are put under constant requisition, and there is a continuous and great responsibility. The conduct of the strikers has been eminently proper, and has won them the sympathies of the public. These *employés*, while thus working, as it were, for a constituted government, have really none of the advantages of government employ—the steady promotion for seniority of service and capacity, and an old age provided for by pensions.

The introduction of female labor, as far as practicable, may be commendable, but the effort to make women competitors of men, is as unnatural as it is economically false. If clever young men once perceive that young girls are to be instruments for the reduction of their salaries, and imperil their chances of gaining a livelihood, it is very probable that the said young men will abandon such an avocation. As for the young girls, in very few cases will they remain to become adepts, but find their natural work in other spheres.

The strike was rather hastily entered into by both sides; but, as we think the company will have to yield much, it were well perhaps that its officers had first given the question more mature consideration.

A NEW UNDERGROUND SYSTEM.

IN the electric era in which we are now living, one of the questions which is at present agitating the minds of the communities in our larger cities, is how to bury the network of wires which now obstructs our highways, defacing our buildings and, in many instances, almost shutting off the sunlight from our houses.

Owing to the numerous objections offered by the various telephone, telegraph, and electric light companies against underground wires, there has, as yet, been but few practical steps taken towards this end, although systems almost innumerable have been presented, varying greatly in style of construction, and in point of practical working. We place before our readers one of the latest plans for underground conduits, owned by the Continental Underground Cable Company of Camden, N. J.

Our correspondent called on the general manager of the company, 205½ Walnut Street, Philadelphia, from whom he received a thorough explanation of the new system.

The company intends placing electric light, telephone, and telegraph wires in the same plant, free from induction and retardation, and in the case of the electric light to do away with the loss in current, which has, up to the present time, been the one great objection to placing these wires underground.

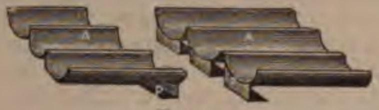


FIG. 1.

The conduit consists of a series of semi-circular galvanized sheet iron troughs, or pockets, in sections of suitable length, supported by a framework of iron arms, cast to an upright, the different sections of which are bolted together; forming a smooth continuous line of pockets from one manhole to the next. The smooth surface of the pockets preventing injury to a single wire or cable while it is being drawn into position

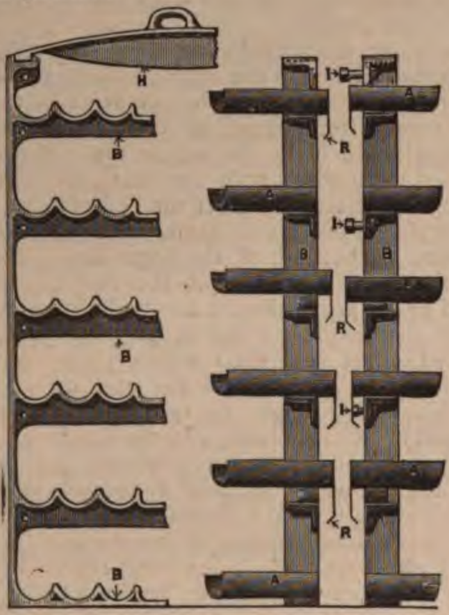


FIG. 2.

After laying this skeleton shelving on a suitable foundation of brick or cement, it is built in with blocks of asphalt compound, made by an improved process, whereby it becomes impervious to moisture and possesses great strength.

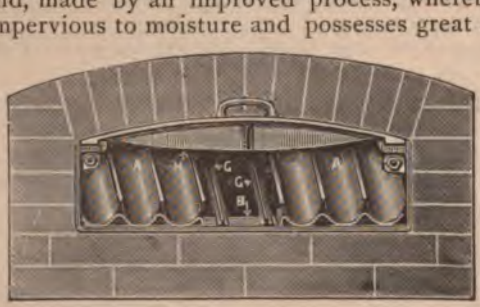


FIG. 3.

An earth connection is made with the metal pockets every few yards, serving to carry off the induced currents which would otherwise escape to surrounding wires. The cables are laid in the conduits by means of a small spring or electric motor, traveling between the manholes on an iron track within the conduit. The motor first carrying through a small rope, and by means of an adjustible arm laying it in the pockets through which the cable is to be drawn, the rope afterwards serving to haul the cable in place.

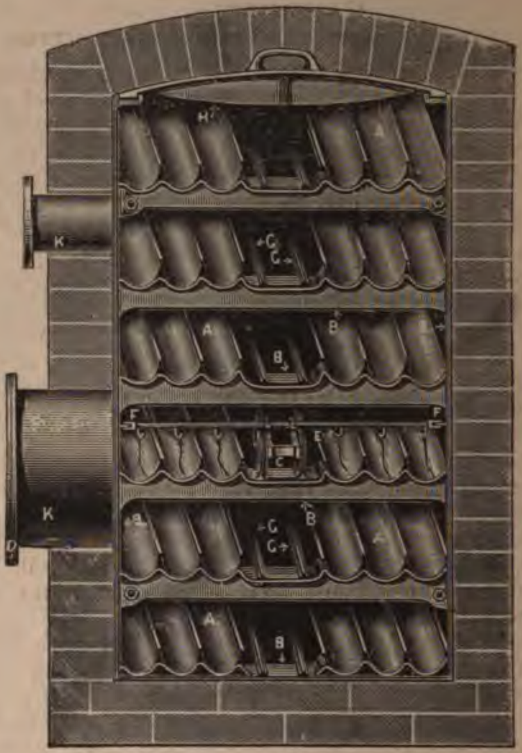


FIG. 4.

Fig. 1 represents the pockets of galvanized sheet iron, and Fig. 2 the cast iron arms, and mode of fastening the sections together after the pockets are in place. Fig. 3 shows a small conduit suitable for branch streets, and Fig. 4 a main line conduit, adapted for from one to six electrical companies, the troughs being arranged in sets of six, with the motor C running on its track in the centre; each trough having a capacity for 200 wires.

The electric light system of this company has a novel feature—that of keeping the air within the conduit under a constant pressure and free from moisture, by passing it through a chemical dryer before pumping it into the conduit.

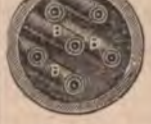


FIG. 5.

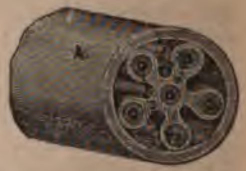


FIG. 6.

Figs. 5 and 6 represent end sections of conduits for electric lighting purposes, in which B are the conductors, and A the metal pipe, the conductors being supported by suitable insulators within the pipe. The councils of Philadelphia, with a practically unanimous vote, passed an ordinance, which was approved by the Mayor on July 7th, authorizing this company to lay its conduits under the principal streets of the city, and it is the intention of the company to be able, in the course of a very few months, to demonstrate the feasibility of the system. The plan seems to meet with much favor, and not a few are loud in their declarations that it is the coming system for laying wires underground.

THE GOLD AND STOCK TELEGRAPH COMPANY.

(*Continued from page* 143.)

THE AUTOMATIC UNIVERSAL TRANSMITTER.

IN our last article we described the hand, or crank transmitter, for the Edison two-wire universal stock printers; our next duty is to explain the form of apparatus, which has, by the operation of natural selection, and the law of the survival of the fittest, gradually supplanted the original type. In the apparatus about to be described, an electro-magnetic motor takes the place of the arm and hand of the operator in furnishing the requisite motive power, the movement of the apparatus thereby being made more rapid, and also, a point of immense importance in printing instruments—more regular. The function of the automatic transmitter is to rotate the type-wheels of all of the printers in circuit to the desired letter or figure, and after this has been done to raise the platen, which prints the impression of the desired character on all the instruments. The subsidiary operation of shifting the type-wheels is also performed automatically, but the whole is under the control of the operator.

The apparatus known as the automatic universal transmitter, consists of two principal parts, which will be first separately described, and then their correlations pointed out and explained.

The first is the electric motor. This engine, which is driven by 6 electropoion cells, known as the No. 1½ size, consists of an upright shaft, pivoted at its upper and lower extremities, and free to revolve in a horizontal plane. About midway between its upper and lower ends, there are rigidly fastened to the shaft a fly-wheel, and just below that 4 radial armatures. The latter are immediately over a circular range of 4 single-spool electro-magnets, fastened on a bed-plate which is pierced with a hole for the passage of the upright shaft. Immediately above the fly-wheel, a two-flanged sleeve encircles the vertical shaft, its upper flange being pivoted, one on each side, to two "stretchers," similar to those used for spreading umbrella covers from the stick which supports the cover. Each stretcher is jointed in the middle portion of its length. The upper ends of these two stretchers are fastened by pivot joints to a collar which encircles the upper portion of the vertical shaft, and which is firmly clamped against the vertical shaft by a binding screw. The latter permits of the raising or lowering of the collar for purposes of adjustment. The space between the upper flange of the loose sleeve and the collar, is occupied by a spiral spring which encircles the vertical shaft. At each of the joints in the stretchers is placed a short arm, carrying a small weight, and this apparatus constitutes the governor of the engine. When the engine runs faster than the rate for which it is adjusted, the two weights are caused, by centrifugal force, to diverge from the centre of motion, and, in so doing, they lengthen the stretchers, thus raising the loose sleeve against the pressure of the spiral spring. This raises a forked pivoted lever, whose fork normally rests on the lower flange of the loose sleeve. The lever then opens the circuit of the battery which circulates in the coils of the electro-magnets, and thus slackens the speed of the engine, and when the reduction in speed causes the weights to approach the centre of motion, the loose sleeve is depressed, allowing the forked lever which rests on it, to fall, thus closing the circuit and enabling the engine to resume its former speed. The fly-wheel ensures the uniformity of speed, which might otherwise be made irregular by the sudden operation of these opposing influences. In some forms of the apparatus, the forked lever, instead of opening the circuit, simply diverts the current through another path of very high resistance, thus weakening the current, instead of interrupting it, which aids in ensuring uniformity and regularity of motion.

Immediately below the bed-plate which supports the electro-magnets, is placed a loose gear-wheel, with 20 teeth, which is connected with the vertical shaft by a friction arrangement, so that it can be stopped while the vertical shaft continues to revolve, and, when allowed to move, is carried on again by the friction connection. It is geared into the great-wheel of the transmitter, the latter having 200 teeth. Consequently, the vertical shaft of the engine makes 10 revolutions to one of the great-wheel, it having been found by experience that a moderately high speed for the former is essential to good working.

Immediately below the loose gear-wheel is placed a cam-wheel, with 4 cams, which is rigidly fastened to the shaft, and which vibrates a pivoted lever, whose office is to open and close the engine battery circuit at the proper times, so as to direct the current through the electro-magnets just when the armatures come within the spaces above the magnets, where the attraction of the latter will ensure the best results.

A condenser, connected around the magnet coils, and a switch to start and stop the engine by opening and closing the battery circuit, complete the engine circuit.

The transmitter proper is constructed as follows: The loose gear-wheel on the engine shaft, having 20 teeth, gears into a great-wheel with 200 teeth, and on the same shaft as the latter, and under the bed-plate of the transmitter are placed two radial arms, which revolve in a horizontal plane in the path of the finger keys. One arm is a prolongation of the other, and the two bisect the circle described by the great-wheel in its revolution. At the right-hand side of the great-wheel is geared a pinion, with 20 teeth, fixed on the same shaft with a 3 cam wheel. These cams vibrate a lever, which opens and closes a local circuit which is led through the type-relays that operate the main circuits. Thirty closings of the circuit are produced for one revolution of the great-wheel. At the left-hand side of the great-wheel, another 20-toothed pinion is fixed on the same shaft with a 6-cam wheel, which operate a pivoted lever, whose function is to open and close the local circuit which passes through the press-relays which operate the main lines, sixty times per revolution of the great-wheel. The rapid vibrations produced by the latter lever do not affect the printing relays until the great-wheel is stopped, when the cams stop in such a position that the circuit is closed as long as the great-wheel remains stationary. A double row of finger keys, 30 in all, 15 in each row, occupies the front part of the apparatus. When a key is depressed, the lower portion of its stem, or shaft, comes in the path of the revolving radial arms. The object of having two arms, is to allow of the placing of the keys in two rows on the anterior half of the transmitter, instead of placing them in one circular row all around the transmitter base, which would be an inconvenient arrangement for the operator.

The depression of a key, then, stops the great-wheel, the two cam-wheels, and the loose gear-wheel on the vertical engine shaft, while the latter continues to revolve. Releasing the key allows the great-wheel and the two cam-wheels to revolve as before.

It follows, therefore, that as long as the great-wheel revolves, the type-wheels of all the instruments will be revolved at the same speed, and in unison with it, and the circuits of the printing wires will be closed whenever the great-wheel is stopped, and will remain closed until the great-wheel starts again. A spiral spring pushes up the key-stem, when the operator's finger is removed from the key-knob. An extra key, when depressed, simply opens the printing-relay local circuit, and thus repeats the last letter printed, provided the key corresponding to the last letter printed remains held down.

In practice, the great-wheel is revolved at the rate of 27½ revolutions, and the type-wheels of the instruments at the rate of 55 revolutions per minute.

Although this machine was one of the earliest of Mr. Edison's inventions, it still remains a great favorite for quotation service in cities, on account of its simplicity and certainty of operation, and the fact that it requires but two line wires. In the later models, the tendency is to revert to the original type, and to use a shifting pad instead of a shifting type-wheel. The mechanism required is essentially the same, while the weight to be moved by the printing-levers of the instruments is, of course, much less, and the battery power, therefore, economized. It should be stated, however, that the details of the shifting device have been much improved in these later models, and a nicety of adjustment produced which was, perhaps, unhoped for by the original inventor.

The reader will observe, by carefully noting the description of the teeth of the gear-wheels, that the great-wheel makes two revolutions for one revolution of the type-wheels. This is done in order to allow of a more convenient arrangement of the finger-keys than could otherwise be secured.

SOME RECENT INVENTIONS IN INSULATING APPLIANCES.

It is well known to all practical electricians, that there is room for improvement in the matter of insulation. In all the practical applications of electricity, insulation plays an important part. The electric current, for whatever purpose it is used, must be prevented from escaping into its great natural reservoir, the earth. If current is lost, force is expended, cost increased, and in case of the electric light especially, danger to life and property incurred.

The appliances in ordinary use, for the purpose of insulating wires, have thus far been tolerated because they were the best of their kind, but serious objections exist to all of them, as is well known to practical men. If in any way, insulation is made more perfect, a commercial advantage is sure to result.

A new departure has been taken in providing insulation for various purposes, by the Chicago Insulating Company, 122 La Salle Street, Chicago, Ill., which has for its object the correction of these imperfections in insulation.

This company is now manufacturing insulating appliances of various kinds and qualities, and is now placing on the market a new knob for electric light wires. These knobs are made of a continuous and homogenous material, and do not depend on a glaze for their durability, a smooth surface being obtained by the method of manufacture. The knobs for indoor use are ornamental, being made in a variety of colors, so as to suit the decorations of rooms. These materials are non-hygroscopic, are not affected by heat, will not collect dust, and there is no danger of firing them by the electric current.

For telegraph and telephone companies, the company has prepared a new pole and knob insulator, claiming to possess superior qualities, and which we understand have been very favorably received.

In addition to these, the company manufacture a fire-proof insulation for electric light wires, by which, it is said, danger, either by fire or by contact through them, is entirely obviated. On this insulation the wires are loosely enclosed in a continuous tube, formed of sections two feet in length, cemented together. The wires may thus be inserted and withdrawn at pleasure, and may be either bare or covered. Besides its high insulating quality, and its being fire-proof, this insulation will not be affected by the weather, or attacked by rats and mice, and will prevent induction from other wires. This is also made ornamental, by covering the tubes with paper, in imitation of any woods desired, or by enclosing them in the mouldings of the room, thus getting rid of the unsightly wires about the walls and ceilings. This insulation is warmly endorsed by the superintendent of the city telegraph department, the fire marshal, and the principal underwriters of Chicago, and has already been adopted by some of the electric light companies doing business there.

THE STEVENS INSTITUTE OF TECHNOLOGY.

The annual catalogue for 1883-1884, of the above institution, informs us that: "The subject of Applied Electricity is taught in a thorough manner, by means of complete appliances, in the way of instruments for electrical measurements, dynamo machines, electric lamps, and the like, so as to fit graduates for responsible positions, in connection with electric lighting, and other similar companies.

"In view of the rapid development of electrical science, and the close relations existing between many of the new applications of electricity, and the work of the mechanical engineer, it has been judged advisable to extend the regular course of the institute somewhat in this direction.

"The fact that a large number of our present graduates hold prominent and responsible positions in the electrical companies throughout the country, sufficiently proves that our course, as heretofore carried out, is well adapted to prepare those pursuing it for the profession of the electrical engineer, who must manifestly be first of all a mechanical engineer, and on this foundation build a certain amount of knowledge and experience in the special theory and practice of electric applications.

"It is believed that by the addition to our former general instruction in electric science of a special department of applied electricity, as a part of our regular course, the actual requirements of the profession will be best met.

"The means of inaugurating this new department, have been placed in the hands of the trustees by President Morton, and it is confidently believed that what may be required for its permanent establishment, will be supplied in due time by those most interested in this subject.

"In this department it is intended to supplement the theoretical knowledge acquired in our previous regular course, by systematic laboratory instruction; in the management and care of batteries, galvanometers, rheostats, electrometers, condensers, etc.; in the measurement of resistances of wires, batteries, insulation resistance, and capacity of cables, electro-motive force, etc. These and other experiments are to be made sufficiently numerous and varied, to familiarize the student with electrical terms, as potential, electro-motive force, resistance, etc.; to give him a realizing sense of the various electrical magnitudes, as volts, ohm, ampère, etc., and to point out the quantitative relations of these units to the ordinary mechanical ones.

"Special attention will then be given to problems in connection with dynamo machines, such as the measurement of powerful currents, determinations of efficiency in generators, and in electric motors, photometry of arc and incandescent lamps, consumption of energy in generator, conductors, and lamps, dimensions of wires for various currents, etc.

"By the courtesy of electric companies, visits will also be made to examine their lighting plant and manufactories."

—— On July 14th, the telegraphic cable connecting Martha's Vineyard with the mainland, was successfully laid by the Western Union Company.

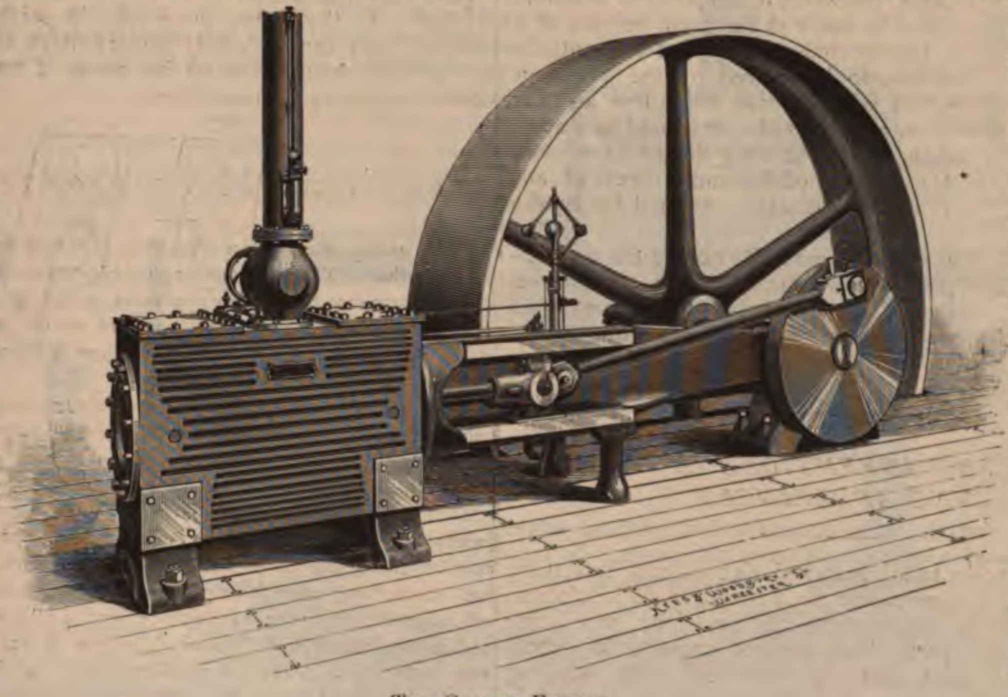
STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

III.—ENGINES INDIRECTLY CONNECTED, ONLY.

THE GREENE ENGINE.

NEARLY all "drop cut-off engines" are constructed, like those described in the preceding article, with a single eccentric, which drives both the steam and the exhaust valves. Both sets of valves must, therefore, have the same motion relatively to the piston, except so far as their motion can be modified, as in the Corliss engine, by the method of connection of valve and eccentric. They must stop and start at the same instant, and their motion during their travel must be more or less similar. But such a system is controlled in its action by the necessary motion of the exhaust valve. That valve must be adjusted to open and to close very nearly at the beginning and the end of the return stroke, in order that the exhaust may be prompt and free, and that the compression shall be right. The movement of the gear, on the steam side, must thus be also one which shall open the valve to take steam at the commencement of the steam stroke, and, if the valve is not tripped, close the port at the end of that stroke. It is further evident, that if the valve is to be detached by its own motion, it can only be tripped during the forward part of its movement, and that, passing that stage, and commencing to return before the cut-off takes place, the valve must be allowed to remain undetached until the end of stroke, and steam must follow full stroke. An engine thus constructed, and so adjusted to its work as to cut-off at about half stroke, will evidently, if the work or the steam pressure becomes variable, be likely to operate very irregularly, at one time cutting off at a little inside half stroke, and then jumping to full stroke. This variation of steam distribution may thus itself introduce a disturbing element, and the engine may give a very unsatisfactory performance. Such an adjustment of power of engine to the work to be done, does not often take place in engines of the class which is here studied, as the best point of cut-off is usually not far from one-third or one-fourth stroke, and the variation in the load is not often great enough to cause serious difficulty in the manner described above.



THE GREENE ENGINE.

One advantage possessed by the arrangement of valve gear, thus subject to criticism, is that, should, as sometimes happens, the valve fail to close, or should it lag behind very greatly, in fast running engines, it is certain that it cannot be left open beyond the end of that stroke, as the returning motion of the valve-gear will bring the latch into gear again, and will insure its closing. Mr. Corliss considers this point of sufficient importance to make it inexpedient to drive the steam valves by the method to be described in this article. It is undoubtedly an advantage to be able to secure such an arrangement of valve-gear that the ratio of expansion may be varied by the governor from the beginning to the very end of the stroke, so that the engine may adapt its steam supply to any load that may be thrown upon it, whatever the extent of that variation may be, and to cut-off at any point from end to end of the stroke. This can be done by the adoption of a gear of the class known, for many years past, from the time of the earliest steam engines in fact, as the "plug-tree" form of valve-gear. It was this class of gear that was used on engines before the days of Watt, that greatest of inventors, for pumping out the deep mines of Great Britain—the Newcomen engine. It may be still seen in use on all so-called Cornish engines, which are to be found in the water works of this and other countries—the most costly, cumbersome, and unsatisfactory style of engine which has been applied to that kind of work in modern times. The distinguishing feature of this gear, is, that it is so adjusted, that the motion of the valve is produced by a mechanism which begins and ends its movement with the action of the piston; in the Cornish engine it is actuated by the engine beam. It is easy to obtain a motion of this character, by the use of an eccentric, by simply setting it so as to make its throw directly with, or opposite to, the crank. In such a case, it is seen that the exhaust valve must be driven by an independent eccentric, and the cost of the engine is thus somewhat increased. This is not a large item, however. The "Greene engine" is an engine fitted with such a valve-motion.

In the accompanying illustration,* which exhibits this machine, the valves are seen to be four in number, as in the engines already described. They are flat valves, instead of cylindrical, and are thought by the inventor to be better than the latter, as being easier to refit when worn, and as being less liable to become leaky. The cut-off mechanism consists of a sliding bar, *A*, driven by an eccentric, set to give it motion parallel to the centre line of the cylinder, and with a movement co-incident, as to time, with the motion of the piston; of a pair of "tappets," *C*, *C*, set in this bar and adjustable vertically in such a manner as to engage the rock-shaft arms, *B*, *B*, on the ends of the rock-shafts, *E*, *F*, which rock-shafts are attached to the valve-links inside the steam chest; of a set of springs which hold these tappets up to their work, and in contact with the "gauge-bar" behind the bar, *A*, and out of sight in the drawing. This gauge-bar is adjusted to the proper height, and is varied in position, as the load varies, by the action of the governor which is connected to the gauge-bar by the rod extending up to it at *G*. The exhaust valves are seen below, and are driven by the second eccentric there shown. They are so placed as to thoroughly drain the cylinder of all water carried into it by priming, or produced by cylinder condensation. The eccentric driving these valves is set at right angles to the position of the crank. In consequence of this independence of the two sets of valves, this engine can cut-off at any point in the stroke during a complete half revolution of the crank. This form of engine was invented by a Providence mechanic, Mr. Noble T. Greene, and was patented in the year 1855. Mr. Greene, then of the firm of Thurston, Greene & Co., introduced this engine a few years after the merits of the drop cut-off had been proven by Sickles and Corliss so fully, that it was easy to secure a market for new devices of this class; and the introduction of this engine has had much to do with the rapid progress of these more economical kinds of engine.

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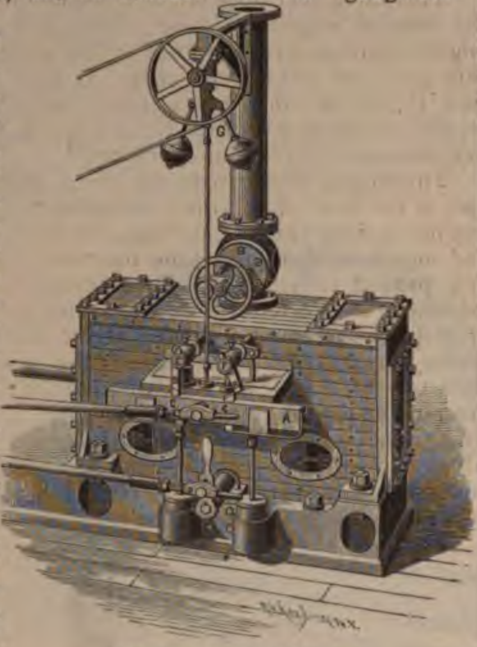
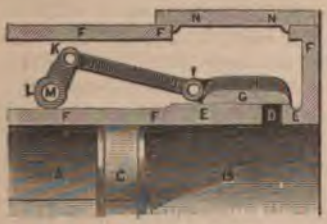
* Hist. of the Growth of the Steam Engine. D. Appleton & Co., N. Y., 1878.



GREENE VALVE MOTION.

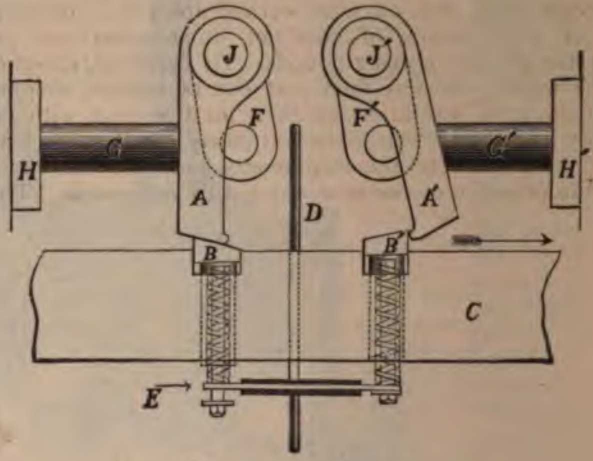
The form of the engine has been somewhat modified at various times, although its characteristic features have been carefully preserved. The steam valve, as designed by the writer, who, at the time of its first appearance, had an occasional opportunity to exercise his powers as a designer on this engine, is seen in the next figure.*



THURSTON'S VALVE.

The valve, *G*, *H*, covering the steam port, *D*, in the cylinder, *A*, *B*, is driven by the rod, *J*, *J*, which is connected to the rock-shaft, *M*, by the arm, *L*, *K*, in such a manner that the line, *K*, *I*, will, when prolonged, intersect the valve-face at its middle point *G*; it is thus so set, that the line of action of the link, *K*, *I*, meeting the valve seat directly under the middle of the valve, does not produce any tendency to rock the latter, and thus to cause wear at the edges, or leaks of steam past the valve into the port.

The latest form of the Greene engine, familiar to the writer, is that now constructed by the Providence Steam Engine Co., and shown in the large illustration above. In this engine, the steam valves are connected to the cut-off mechanism, by a set of rods or stems running parallel to their seats, and emerging into the air through stuffing boxes, properly provided with easily set and easy working packing; these valve stems are connected to the rock-shafts, and are driven as in the arrangement already described, very nearly; this design has some advantages over the old, in keeping the working parts, and especially the joints, out of the steam space. The exhaust valves are gridiron slides, set to travel across the line of the cylinder, and driven from a horizontal rock-shaft, extending forward to the eccentric on the crank-shaft; the governor is a Porter loaded governor, driven by a belt from the main shaft; the cut-off mechanism is illustrated in the last of this series of illustrations.



GREENE TRIP MOTION.

The tappets, *A*, *A*, are carried by the rock-shafts, *J*, *J*, which, in turn, drive the arms, *F*, *F*, and the valves attached to the stems, *G*, *G*, passing through the stuffing boxes, *H*, *H*; the tappets, *B*, *B*, engage these rock-levers, and are adjusted vertically by the governor rod, *D*, and held up against the gauge bar or the rock-lever, as the case may be, by the springs set in the sliding bar. When the speed of the engine is above that for which the engine is set, the governor, acting through the rod, *D*, depresses the tappets, and they do not retain their connection with the rock-lever as long as when at normal speed; when the speed falls below that fixed by the constructor, the governor rod rises, and the tappets are thus permitted to rise, and to remain in contact with the rock-lever, holding open the steam valve for a longer period than before. The longer the valve is to be kept open, and the farther the steam is to follow, therefore, the wider does the port open to steam. When the tappets travel to the point of cut-off, they swing clear of the rock-levers; the weights, acting together with the pressure of steam upon the valve-stem area, quickly shut the port, and the steam is allowed to expand from that point on to the end of stroke; the higher the tappets are permitted to rise, by the elevation of the gauge-plate, the greater the ratio of expansion; the further they are depressed, the shorter the cut-off. As these engines are constructed, they are capable of cutting off steam anywhere between the beginning and three-quarters stroke; the latter limit is determined by the lead, and by the margin thought necessary to secure certainty of closure of the valve, when tripped, before the piston reaches the end of its stroke. To follow farther would not be likely to be of advantage, as the gain in the mean total pressure would be compensated by the loss due to a retarded exhaust. A safety stop-motion is combined with the governor connection, in such a manner, that if the belt breaks, or is thrown off its pulleys, the steam will be at once shut off, and the danger of accidents, such as sometimes occur with a run-away-engine, is avoided. The valves and seats on the exhaust side are both easily removable, from the outside, have outside connections, and are readily adjusted without interference with the steam side.

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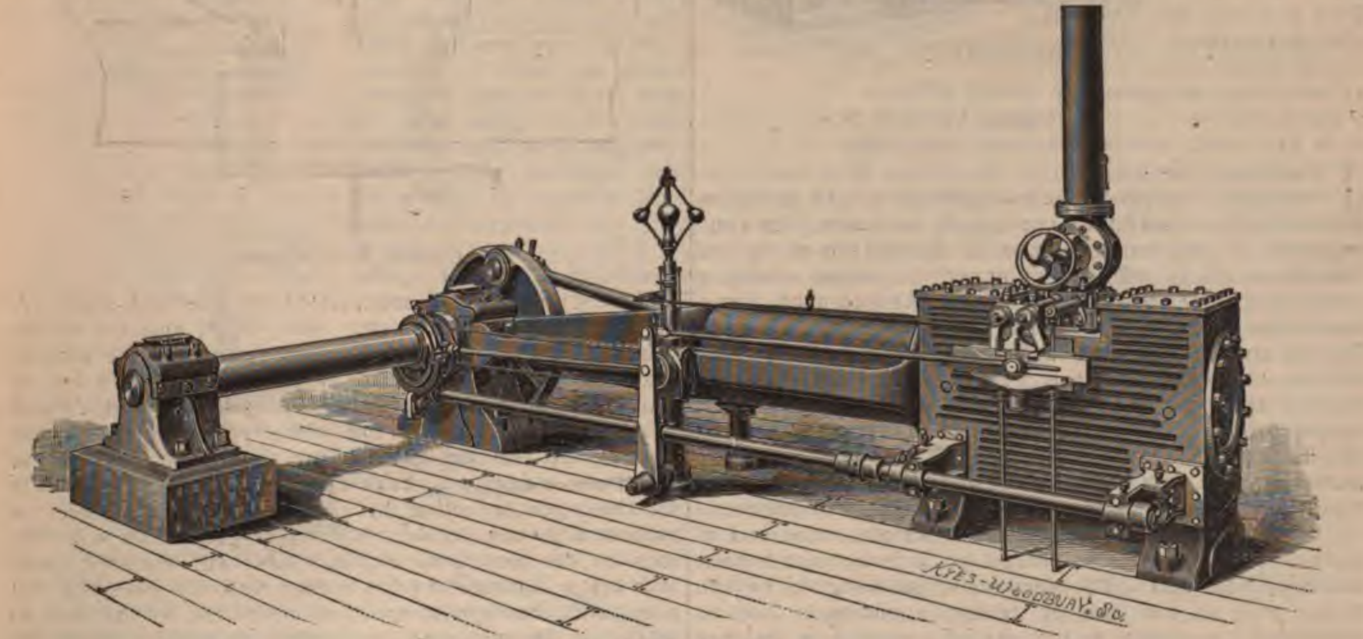
* Supplied by D. Appleton & Co.

These engines have been, next to those of Corliss, the pioneers in the movement, during the past generation, toward economical working of steam. An engine built upon this plan, substantially, by the firm of Thurston, Gardner & Co., nearly a quarter of a century ago, from designs prepared by Mr. E. D. Leavitt, Jr., for a well-known Eastern mill, had steam-jacketted cylinders, 26½ inches in diameter, 5 feet stroke of piston, made 50 revolutions per minute, with steam at 100 pounds pressure in the steam chest, and, on trial, worked down to a consumption of 1.98 pounds of coal per horse-power and per hour; the guarantee was 2 pounds. Its fly-wheel, designed by the writer, who was then just out of college, weighed about 20 tons, was fitted up as a mortice gear, with cut hickory teeth, and was given extremely small side clearance; the motion of the engine was so smooth, however, that the presence of the gear was hardly noticeable. This engine was fitted with the gridiron slides, as in the above illustration; they were driven by sliding cams, thus obtaining a rapid opening and closing of the exhaust, and a slow movement while in the intermediate position, with the port either open or closed. This was a remarkably good piece of work for that time, and has not often been excelled since.


Kiles-Woodbury Sc.

THE GREENE ENGINE.

This engine, like other engines with drop cut-off valve-motion, is not adapted to such high velocity of rotation as to permit it to work safely at the speed of even the largest and slowest of the modern "dynamos;" but, belted to the machine, it will give as great economy, and as great perfection of regulation, as engines of the preceding class. It is evidently so arranged that no load is thrown upon the governor, and the effort to detach the steam valve is, therefore, not liable to cause any oscillation in the cut-off gear, or variation in the speed of the engine. In all these engines, the difficulty met with by the designer is, not to secure this independence of the governor from the action of the valve-gear, but to prevent the irregularity which comes of the oscillations of the governor itself. The dash-pot attached to the governor, or, sometimes, a friction mechanism, prevents such irregularity.

This valve-gear does not as conveniently adapt itself to the vertical engine as some others, but one of the first engine-cylinders ever designed by the writer, was built with this gear, and was set vertically. It gave perfect satisfaction, if the fact that it was never reported to the shop for repairs, so far as the writer has yet heard, may be taken as evidence of its successful operation.*

This engine was introduced over a quarter of a century ago, in the face of a strong competition from the Corliss engine—a fact which is, perhaps, the best evidence that it had merit—and by the same methods which Mr. Corliss had proved so effective. Guarantees were given of performance, and forfeitures were provided for in the contract; or else the agreement was accepted to take as payment the saving actually effected in a fixed period of time—usually from two to five years, according to the character of the machine displaced. One of these engines, with which the writer was familiarly acquainted through his indicator, and which displaced the rival engine on such a guarantee, has now been in operation 23 years, and is reported to be to-day still in perfect order. The engine referred to above as having given so excellent a performance, was put in under an agreement by which the builders agreed to forfeit $1,000 per ¼ pound that the coal consumption should fall short of the guarantee. The manufacture was interrupted for some years by an injunction secured by Mr. Corliss, after a suit brought by him for infringement, but was recommenced after the expiration of the Corliss patent, and has proved a successful enterprise, notwithstanding the fact that its constructors have depended, apparently, upon the performance of the engine itself for advertisement—a conservative system of doing business which few manufacturers adopt, at present.

All three of the great inventors and introducers of the modern American type of steam engine—Sickles, who brought into use the drop cut-off; Corliss, who gave the stationary engine its now standard form, as well as devising his peculiar valve gear; Greene, who applied the principles of this system of working steam to the plug-tree form of valve gear,—are now still living. Mr. Corliss has acquired wealth, as well as fame; his predecessor and his rival, however, have attained less fame, much less than they are entitled to, and still enjoy all the advantages which poets ascribe to the possession of small means. Neither of them expects to be able to build a monument, in the shape of a great technical school, such as it is becoming customary for wealthy engineers, like Stevens, and Rose, and Stone, to erect

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* This engine is still in use, after 22 years service, and drives a set of dynamos at South Webster, Mass.

There are other engines belonging to the class here considered—the engines having a detachable cut-off valve closed independently of the motion of the valve-gear,—of which the space proposed for these articles will not permit description. Among these are the Wright engine, constructed by one of the oldest and best known designers in the country; the Brown engine, a machine which has been extensively adopted for driving mills in New England, and is famous for the excellence of its workmanship and finish, as well as for its durability and efficiency; the Fitchburg engine, and others.

Errata in Part III, June No. In the fourth paragraph, for "Poughkeepsie" read "Providence." In next to last paragraph, for "by a spring" read "by a spring, or by the weight and vacuum dash-pot."

SKETCHES OF ELECTRICAL HISTORY.

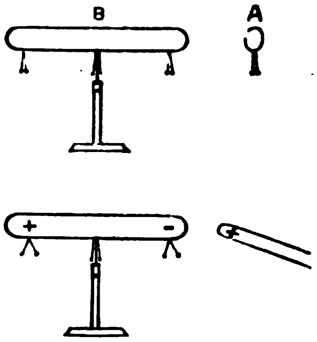
BY WALLACE GOOLD LEVISON.

XI. STATO-ELECTRIC INDUCTION.

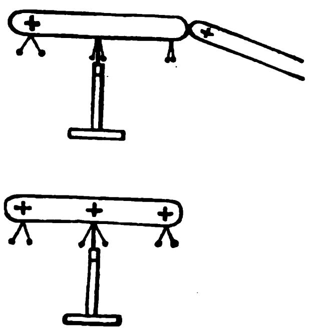
It was early recognized that the surface of either a conductor or non-conductor supported by silk cords (or otherwise insulated), might be equally well electrified; but, that while a cylinder made of metal would be instantly and completely discharged by contact with a conductor leading to the earth, the electricity would be removed from but a small area surrounding the point of contact of the discharging conductor with the surface of the non-conducting cylinder.[1] Conversely, it was determined that electricity applied at one point to an insulated metal cylinder would spread instantly, and, in a sense, equally over its whole surface; but would spread over a cylinder of non-conducting material, such as glass, progressively, in small areas at a time only, and very slowly. The better adaptation of metal cylinders for prime conductors, and similar experimental apparatus, was, therefore, understood, and their use led Mr. Stephen Grey, in August, 1729,[2] while pursuing the experiments that so considerably advanced electrical science, incidentally to notice that a perfectly neutral, or natural, insulated metallic cylinder would, upon the approach of an electrified body, exhibit strong evidences of electrical excitement, and yet upon removal of the electrified body would resume its normal condition. The phenomenon thus observed, next attracted the attention of Mr. John Canton, who, as one of the results of the first strictly defined qualitative investigation on record, laid before the Royal Society, on Dec. 6th, 1753, a series of experiments, which demonstrated that the electrical excitement of the insulated cylinder is chiefly confined to the ends.[3]

Until this period, the development by friction of vitreous electricity from glass, and resinous from rosin, were supposed to be essential and immutable properties of glass and rosin; but Benjamin Franklin, having repeated the experiments of Grey and Canton was enabled, by the application of his + and — theory, not only to extend them by establishing that the electricity excited upon opposite ends of the cylinder is of opposite kinds, and that *either kind of electricity* might be *permanently communicated* to the cylinder from *either* glass or rosin, but also to express, in unequivocal language, the principle they indicated[4].

The efforts of Wilkie and Æpinus to mathematically confirm the theory of Franklin, led to the recognition of the principle, thus revealed, as the essential feature of almost every electrical phenomenon. While, however, it was the Franklinian theory that led to an appreciation of its importance, this principle may be, perhaps, most clearly and briefly explained by the aid of the following experiments, and the two-fluid theory which Mr. Robert Symmer[5] evolved from the discovery of Du Fay.



Figs. 54 and 55.



Figs. 56 and 57.

Three Cavallo electroscopes, of delicate silver wire, are attached to wire rings, one of which is shown at *A*, Fig. 54, of such diameter that they may be easily slipped over an insulated metallic cylinder, *B*, and adjusted to the positions shown, one near the middle and one near each end, the rings being omitted from the figure to avoid confusion. The electroscopes will hang inert, as shown in Fig. 54, but if an excited electric, such as a glass tube, be brought near the cylinder, the terminal electroscopes will diverge, as shown in Fig. 55. Remove the tube, and they collapse; move it toward the cylinder again, and they will again diverge, as was shown by Canton. Since the electricity, which affects the electroscopes in these experiments, is set free only by the influence of the neighboring electric, it is said to be induced electricity, and the method of thus developing it, is called electrical induction. Franklin showed that the terminal electroscopes are diverged by opposite electricities, as indicated by the signs + and — in Fig. 55; and, according to the two-fluid theory, the excited glass tube induces a separation of the two electricities, which are naturally contained in equal quantities in the cylinder, by attracting the negative and repelling the positive electricity, and thereby causes the accumulation of the opposite electricities at opposite ends. According to this assumption, the common process of charging by contact is thus easily explained. The tube being touched to the cylinder, as in Fig. 56, the electroscope nearest it collapses,[6] because some of the + electricity of the tube neutralizes the — electricity of the cylinder, which, by induction, is accumulated at that end. Now remove the tube, and the cylinder is left charged with + electricity, all three electroscopes diverging equally, as in Fig. 57.

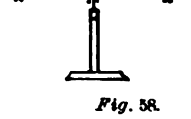


Fig. 58.

The cylinder may, however, be charged with — electricity from the same positively excited tube, the method and its explanation being as follows :

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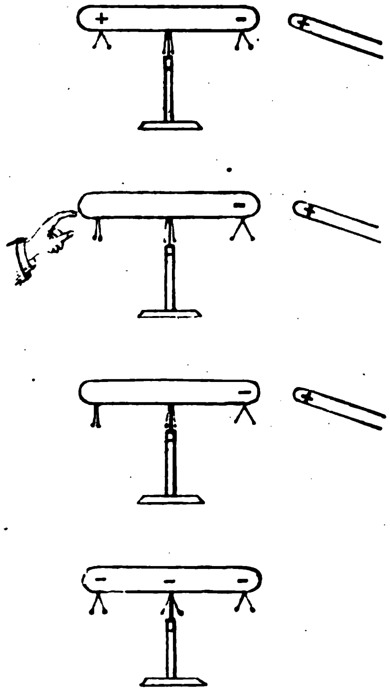
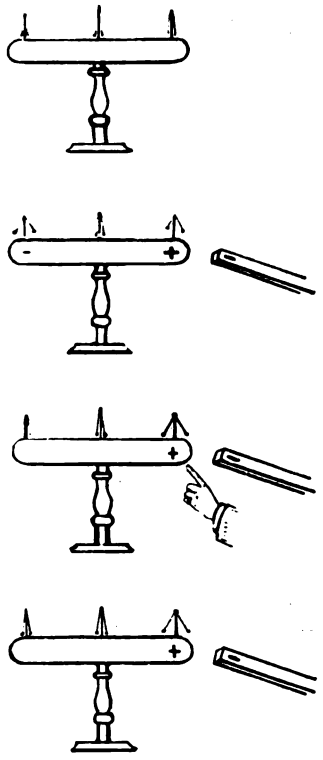
[1] See Electrician. Vol. I., p. 283.
[2] Priestly's Hist. of Elec.
[3] Lardner's Cab. Encyc., London, 1841; p. 70. Phil. Trans., 1753; p. 350.
[4] Lardner, Loc. Cit. P. 70.
[5] Phil. Trans., 1759.
[6] But will, probably, immediately diverge again.



Figs. 59 to 62.

B. Fig. 58, being the normal cylinder, bring near it the excited tube, as in Fig. 59, and the terminal electroscopes diverge with opposite electricities, as previously explained. Apply the finger to the cylinder, as shown in Fig. 60, and a supply of — electricity coming from the earth neutralizes the free positive electricity repelled by the glass tube, and the most distant terminal electroscope collapses. Take away the finger, as in Fig. 61, and no change occurs. On finally removing the glass tube, however, the — electricity, which had been concentrated at one end by the influence of the glass tube, spreads all over the cylinder, thus leaving it uniformly charged with — electricity, and all the electroscopes divergent, as seen in Fig. 62. By means of the movable rings, the electroscopes may be adjusted at various relative positions upon the cylinder, and it will be found that the neutral point is seldom precisely in the middle, but varies under different circumstances. Since the supporting column is in the way in these experiments, some prefer to use electroscopes mounted on little wires provided with feet, so they will stand upright on the cylinder, or which may be inserted in holes drilled in a line along its top, as shown in the next figure. The inverse of the last experiment, or the process of charging a cylinder with positive electricity, by means of a piece of sealing wax negatively excited, is presented in the series of Figs. from 63 to 67. A certain fact, important to understand, namely, that the finger may be applied to the cylinder at any point indifferently, is indicated in Fig. 65, for even though it be touched to the end nearest the inducing electric, it is always the repelled electricity that escapes or becomes neutralized.



Figs. 63 to 66.

By an important application of this principle of induction to the ordinary aluminum leaf electroscope, it has been long employed to indicate not only the existence of free electricity, but also its kind. As in Fig. 68, the leaves are first diverged by induction with + electricity. While the inducing electric is still held in position, the finger is applied to the ball of the electroscope, and the leaves collapse because the repelled + electricity is neutralized. The electric being then removed, the leaves again diverge and remain for a long time divergent with — electricity. A body excited with + electricity, presented to the electroscope, will then cause them to approach, while a body excited with — electricity will increase their divergence. One more illustration will indicate how the ordinary phenomenon of attraction and repulsion may be regarded simply as a consequence of electrostatic induction.

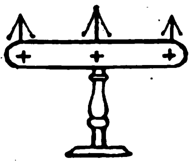


Fig. 67.

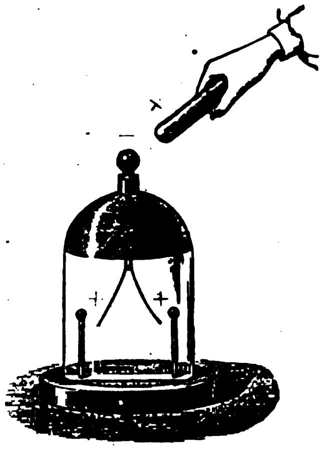


Fig. 68.

Thus, let 1, Fig. 69, represent the pith ball of an electrical pendulum. The excited glass tube dissociates its natural electricities, repelling the + and attracting the —, and as the latter is nearer the glass tube than the former, attraction overbalances repulsion, and the pith ball swings to contact with the tube, as shown by the dotted outline, No. 2. Its — electricity is then neutralized by a portion of the free + electricity of the tube, and the pith ball, charged with free + electricity, is then repelled by the excess of + electricity upon the tube, as represented by the outline No. 3.[7]

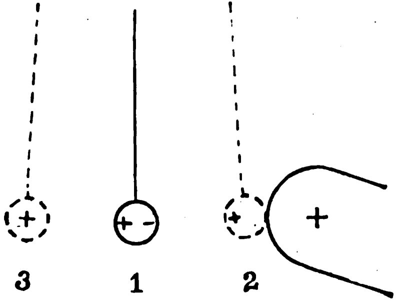


Fig. 69.

SOME COMMON MISTAKES IN ELECTRO-DYNAMICS.

Office First District,
Edison Electric Illuminating Co. of New York,
257 Pearl Street.

New York, July 12th, 1883.

To the Editors of the Electrician:

ELECTRICITY is unfortunate in having some very strongly marked characteristics which have always been associated with the supernatural only. Upon the discovery of electricity, and during the earlier stages of its study and development, this fact caused a deep rooted impression that electricity was some incomprehensible spiritual thing which could not be understood or controlled by man, an idea, which, in its now milder forms, is wearing off very slowly indeed.

There is still an air of witchery hanging about electricity, which, as long as it is fostered by popular ignorance, will stand in the way of its taking its proper place at the head of the list of useful dynamic agents. The fact is, that it is a form of energy just as much as heat or even mechanical energy, and follows well defined laws just as certainly as do these and other forces, and can be just as well controlled. The only difference is, that, being a much higher form of energy its laws are, I may say, correspondingly more definite or scientific, and while to most people the general laws which heat follows in a rough way, are more easily comprehensible, yet the extremely intricate formulae of the science of heat —thermo-dynamics—which it is necessary to employ to obtain results of any accuracy with this form of force, are understood by very few indeed.

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[7] For the sake of simplicity, the inducing electric in these experiments is represented as a rod of glass or sealing wax. As a matter of fact, the + or — prime conductor of an electrical machine is better adapted to perform them effectively.

To impress this idea let us take a specific example: The amount of electricity which will flow through a conductor in a given time equals the pressure, or, technically, the electromotive force, with which the electricity starts out, divided by the resistance which the conductor offers. Thus, with a pressure of twenty units, and a resistance of five units, the strength of the current flowing will be four units. This is Ohm's law, which is considered so wonderful; but which, as a matter of fact, is an axiom universally true, that an effect is equal to that which tends to produce it, divided by that which opposes it. One of the characteristics of electricity is what may be called its exactness so that in electro-dynamics this simple axiomatic relation invariably holds true with absolute accuracy, and electricians spend a large part of their lives in learning to realize that a great number of the problems which they meet more or less encumbered with details, reduce to the simple application of this law.

In the cases of the flow of water, compressed air, steam, etc., the same principle holds, but to get close results, it is necessary to consider the very great complications arising from the fact that the resistance to the flow is not uniform over the whole cross-section of the conductor or pipe, but that most of it is where the outside of the stream rubs against the inside of the pipe, the outermost particles of the fluid being thereby retarded, and in turn retarding in a less degree those next to them, and so on. To add to this, the resistance to fluids in motion varies with the rate of flow.

The general effect, of resistance lessening the flow, is the same with fluids as with electricity, and people will grasp the idea more readily, if stated in application to them, because they are more familiar with fluids. But when we come to solve practical problems in the flow of fluids, to cover all the factors it is necessary to employ complicated formulae which cannot compare in simplicity with the very simple and exact electrical rule, $S = \frac{E}{R}$

This rule is always applicable to every case in electro-dynamics, whereas in hydraulics and most of the other sciences it is necessary to have special formulae for different cases, and these are constantly being improved and changed, and they are all of greater complexity. Vide one for determining the flow of water in a canal:

$$Q = \frac{\sqrt{2gh}}{\sqrt{\frac{1}{F_1^2} - \frac{1}{F_0^2} + Z\left(1 + \frac{a}{c}\right)\frac{lp}{F_0 + F_1}\left(\frac{1}{F_0^2} + \frac{1}{F_1^2}\right)}}{}^{*}$$

Electricity has, in a very high degree, some peculiar properties, in consequence of which it is remarkably well adapted for accomplishing certain ends, but it is just as great a mistake to expect electricity to do everything, as it is to fail to recognize its special adaptability to certain purposes.

It travels, so to speak, at an enormous speed through very small and cheap conductors, and can be converted at once into either light, heat, or power, many times more economically than can heat and other forms of energy.

The public have learned to appreciate the speed of electricity, and now make exclusive use of it as a means of instantaneous communication. When they have learned its simple and economical convertibility at pleasure into any or all of the effects above alluded to, they will introduce systems for distributing electricity for those uses, as unquestioningly, as they now put up water works and telegraph lines.

But, on the other hand, allowing people to attempt to obtain by electricity, results, which are better accomplished in some other way, is a mistake that will only lead to disappointment, and the temporary disfavor of electricity as an agent.

Again, there is a great deal of misapprehension in regard to the loss attending the conversion of mechanical work into electricity, and vice versa, or the "cost of electricity."

The efficiency of the best dynamo-electric machines, by which we make this transformation, is about 95 per cent. That is, in transforming mechanical into electrical energy, about $\frac{1}{20}$ of the power used—is lost, while we get $\frac{19}{20}$ in electricity. And yet, we frequently hear men, the importance of whose positions gives weight to their opinions, say that electricity is wonderful and man has learned to control it, but it is so costly to produce, that it cannot be used commercially until obtained in some cheaper way.

There is a very prevalent idea that there is room for improvement in the working economy of electric generators. Because considerable coal is consumed in the production of electricity, most people imagine that electric generators are very wasteful. This is not so. Almost all the loss is in the steam engine which drives the electric apparatus. Of one hundred parts of energy in the coal, the very best steam engine made brings out only about fifteen in mechanical power, while of this fifteen, when applied to drive a generator of electricity, the yield in electricity is over fourteen.

I have been several times called upon to give opinions of alleged improved generators, for which were claimed from two to four times the efficiency of present machines. That is, it was claimed that for the same amount of power put in, they would yield from two to four times as much electricity as the machines in use. And, in both cases, the inquirers, after being told repeatedly in different ways, that obviously a machine cannot be made with from two to four times the present efficiency of 95 per cent., that if the present machines return in electricity $\frac{19}{20}$ of the power put into them, others cannot be made to return twice as large a *part*, the answer, or, rather, the next question has been, "Can't it be, that this improved machine gives a better quality of electricity which will do more work"? They might as well ask if a water wheel would give twice as much power if a better quality of water were used. This precisely similar mistake is not made, because people are more familiar with water.

There can be no doubt that the best dynamos are electrically perfect, excepting the loss of a fraction of one per cent. of the electricity, by conversion into heat, in passing through the generator itself. The other loss of 5 per cent. is a very small allowance for the mechanical resistances to the rotation of the armature.

Electricity should be viewed merely as a stepping stone, or as a vehicle in the translation of energies. A form in which energy, after being changed, can be transmitted, kept, controlled, &c., to be translated into useful effects as desired, much more perfectly than by any other means.

SCHUYLER S. WHEELER.

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[*] Weisbach's Mechanics; p. 970.

THE ELECTRIC RAILWAY AT THE CHICAGO EXPOSITION.

CHICAGO, July 13, 1883.

To the Editors of The Electrician:

I VISITED the "Exposition of Railway Appliances," recently held here, and made as thorough an examination as circumstances would permit, of the electric railway.

The road was built in the gallery, and extended round the entire circumference of the building, a distance of about one-third of a mile. It consisted of two ordinary T rails, and a third flat thin rail, set on its edge in the centre between them, to act as an electric conductor, under which was placed a heavy copper wire, to insure continuity. The steam power was supplied by a large Corliss engine, used also for other purposes, and the electric power by two Weston dynamos, each of about 14 horse-power; the primary dynamo stationed near the engine, and the secondary placed on the electric locomotive, to which was attached an open platform car, seating 20 persons. The locomotive was simply a car containing the dynamo, with the shafts, band wheels, and appliances for communicating the power to the driving wheels; and the apparatus for receiving the electric current, and regulating and controlling speed. The steam engine was the source of power, which was converted into electric force by the primary dynamo, and transmitted by wires to the track; one wire connecting with the outer rails, and the other with the central rail, against which a pair of brushes, pressed lightly, one on each side, conveying the current up to the dynamo, from which the downward circuit was completed through the driving wheels and outer rails, connecting with the other wire from the primary dynamo. A belt from the band wheel on the armature shaft, extended forward, communicating with the machinery connected with the driving wheels. A rheostat and switch enabled the engineer to increase or diminish the resistance as required, and thus control the speed; while a lever connected with the driving wheel machinery, and operated simultaneously with the rheostat, gave the necessary mechanical control; so that the stopping, starting, rounding the curves, or moving in a straight line, were all accomplished with great facility; the adjustment of power and resistance being, apparently, as perfect as could be desired. The locomotive weighed about three tons, and the loaded passenger car about the same, making the entire weight of the train about six tons.

The road was well patronized; and, carrying 26,508 passengers in 13 days, at 10 cents each, was a prominent source of income.

As a practical experiment, showing the progress already made in the use of electricity as a motor for operating heavy machinery, it was a great success, and full of promise for the future; but as a demonstration of the economic use of electricity as compared with steam, it fell short. In fact it was a practical proof to the most casual observer that the problem is yet unsolved.

The apparent facts were these: 17.5 horse steam power, transmitted through two dynamos, each 14 horse-power; a sum total of machinery equal to 45.5 horse, doing the work of one horse—the movement of a car containing 20 passengers. The movement of the locomotive itself cannot be included, as it was a necessary part of the machinery, and an additional item of expense.

Such were the *apparent* facts, but a careful examination gave a more hopeful view. Allowing 20 per cent loss by friction in the primary dynamo, the 14 horse-power obtained from it required 17.5 horse-power from the steam engine, and, allowing 30 per cent. loss by transmission and friction between the primary and secondary dynamos, we have 9.8 horse-power to move the train; dividing this equally between the locomotive and car, we have 4.9 horse-power brought into effective use in carrying the 20 passengers; 28 per cent. of the original 17.5 horse-power from the engine.

From this it will be seen that there was 80 per cent. more power developed than was necessary to move the car; 4.9 horse-power to do the work of one horse. This was because the road was built on a shaky gallery, 20 feet above the ground, and it was not considered safe to run the car to its full capacity. For the same reason the speed could not with safety, exceed 8 to 10 miles an hour.

Estimating the cost of power generated by a stationary engine at one fifth of that generated by a locomotive engine, we find that the 28 per cent. effective power, calculated above, was obtained at 20 per cent. of the cost for steam; 28 per cent. power at 20 per cent. cost, equals 100 per cent. power at 71 per cent. cost; 29 per cent. in favor of electricity. As an offset to this, there is the cost of the two dynamos, their care, repairs, and percentage of wear: to which must be added the loss by resistance, and otherwise, in transmitting electric force over long sections of road.

On the other hand, the advantages of electricity over steam power for street railways, in getting rid of smoke, steam and cinders, must not be overlooked; whether for elevated roads, as in New York, tunnel roads, as in London, or those on the level.

The above estimate, though made from the most reliable data which could be obtained, can only be regarded as approximately correct. In fact, strict accuracy was impossible, as there was no apparatus for taking measurements; and the capacity of the dynamos was the only thing known with any certainty. The road and its appliances were hastily constructed, and there was not time or opportunity to make the experiment with that regard to accuracy which its importance demanded. What the managers aimed at chiefly, was to demonstrate, that it was possible to propel a car, and carry passengers by electric force; and, so far, the experiment was a decided success.

It yet remains to be seen what can be done with a road well constructed, on a solid bed, in a straight line, or with only the average amount of curves, with all the power utilized to its full carrying capacity, and with proper apparatus to make strictly accurate mathematical measurements. But so long as electricity is generated by steam, it can hardly be expected that it can be applied more economically than the steam power, on which it must depend.

The great unsolved problem, is the generation of electricity by some method cheaper than steam. The principal methods proposed are improved batteries, secondary or storage batteries, dynamos operated by water power and the electric force transmitted by improved conductors. But so long as electricity is dependent on steam, it is safe to assume that steam will remain king.

P. ATKINSON.

To the Editors of the Electrician.

GENTLEMEN: In your July number appears an interesting letter, from Mr. W. R. Cabot, in answer to an article by Mr. Essig, on the mingling of telephonic signals.

In connection with this correspondence, the following may be of interest:

In this office, in addition to the usual switch board for subscribers' wires, is a telephone instrument attached to a private line. This line has no connection whatever with the switch board or its wires. This line, and all of the switch board wires, are strung on the same poles for a distance of three miles, and have entirely separate and distinct terminals. Conversation can be carried on, distinctly, from one line to the other. To make sure that the voice of the speaker in the central office had no effect on the coils of the switch board, the wire was disconnected from the board and given a ground entirely by itself. Still, the conversation could be carried on, from wire to wire, as distinctly as before. Very respectfully,

G. A. ROULLIER.

Flushing, L. I., July 23, 1883.

THE INVENTION OF THE TELEPHONE.

CLIFTON, S. I., July 24th, 1883.

To the Editor of the Electrician.

DEAR SIR,—In order to substantiate Mr. Bell's priority in the invention of the telephone, under the date of March, 1876, which is so lengthily sustained in the communication of the 21st to all the leading papers, the examiner at the patent office, Washington, ought to be able to annihilate, with substantial facts and demonstrations, the three caveats which he, his predecessor, or the Commissioner of Patents, granted to me in the years 1871–1872–1873, through the patent solicitor, Thomas D. Stetson, for my application of same invention, and which three copies are always in my possession, open to public inspection.

When such evidence shall be brought forth and made public, I shall not hesitate to yield the priority of invention to Mr. Bell, or any one else who might be entitled to it; but until then, I shall not abandon my rights, and shall call myself, by valid documents, the first American citizen who has obtained from said patent office at Washington, a caveat which entitles me to the priority of invention of the great contended telephone.

Very truly yours,

ANTONIO MEUCCI.

HEAT LIGHTNING.

(For the Electrician.)

NOW that the season of thunder storms has come, it is possible to make a great number of observations, useful to the progress of meteorology, and the physics of the air. One of the problems in the order of the day, is to determine the nature of heat lightning, which often lights up the sky at sunset, and is always followed by more troublesome disturbances, such as a torrent of rain, or a stroke of lightning.

Many physicists assert that these flashes are only the reflections of lightning, so far distant that the noise of the thunder cannot be heard. This opinion has gained ground during the last few years.

The problem could evidently be solved in a single season, by observing, from an elevated place, the number of flashes, and the times at which they occurred, and comparing the results with the number of strokes of lightning observed in the same time at other places. If all the heat flashes noted during one summer were traced to this source, there would be no foundation for the theory that they are similar to the aurora borealis. We believe that these luminous phenomena, only occur in those regions where the old philosophers located the fire zone, and where cirrus clouds are not formed

There is little use, we think, in insisting upon the importance of this kind of information, and it cannot be obtained from observations at fixed hours, with which the French meteorological bureau is too easily satisfied. As has been well remarked somewhere, dame nature is not a government clerk, and has no office hours.

Another problem of equal importance, is to determine the form of the clouds which portend a thunder storm. It would be necessary, for scientific accuracy, to photograph the sky every time such clouds were formed. It would also be necessary, in order to complete the data, to scatter observers over the neighboring country for a distance of thirty or forty kilometres. Ten such stations would suffice.

We cannot too earnestly urge the friends of natural science to unite to study this problem without recourse to government aid. For these researches require a freedom which official bodies do not possess; the creation of such a corps of observers, would probably end in only increasing the number of citizens, to whom science furnishes an excuse for living at public expense.—W. de F., in *L'Electricité.*

F. W. STONE.

OUR PARIS CORRESPONDENCE.

PARIS, July 5th, 1883.

NO great animation may be expected during the summer time, from electric enterprises The fine weather is their dull season, as in every workshop preparations are made for the busy period, which begins in September. It is very natural, therefore, that there is not much talk about the doings of electricians just at this moment. The Vienna exhibition will give electricians, however, an opportunity of bringing themselves before the public, and they are now busily engaged in preparing for it. From personal information which I have received, the exhibition will be a remarkable one, and well deserving the attention of electricians, although it comes scarcely two years after that of Paris. Without intending to pose as a prophet, I believe that a practical solution will be exhibited there of the electric transmission of power to a distance, and that a concise idea of the services it can render, may be obtained. The industrial product—that is, the proportion of work obtained on the receiving shaft to the work expended on the shaft of the generator—is now more than 50 per cent. for a certain class of machines, when a copper conducting wire is used, and that it is as insulated as possible; the distance between the machines would be about three miles. This is only a first estimate, and it is very probable that better results may be obtained. We shall not be left in uncertainty very long with regard to this point, as a committee, composed of Messrs. Tresca, member of the Académie des Sciences; Potier, professor at the Ecole Polytechnique; and Marché, president of the Society of Civil Engineers, are now carefully examining the machines that have been specially built by the Compagnie Electrique for the transmission of power There is also some talk of employing small electric machines for working the ventilators in the new Hotel de Ville in this city. Their use in such a case would be in natural order, and would, besides, considerably simplify the fitting up.

Our readers may be, doubtless, of the opinion that we return rather frequently to this transmission of power; but we are compelled to consider the question, as it is the only one where something yet remains to be discovered. The electric light would seem to conceal no more mysteries; there are so many machines, regulators, and incandescent lamps, that one must have a robust faith in an inventor, to believe he can offer any new discovery of importance. There is very little attention being given to accumulators and even in England, where they are more especially advocated, it is recognized that their only advantageous application is for traction on tramways; if they are suited for such work, is even questioned. There is, therefore, a certain amount of discouragement among those who believed, too readily, that electricity was going to revolutionize industry

Some electricians, backed by *savants* and engineers, have, therefore, thought it high time to form themselves into a society for the defense of electric interests. Some two or three months ago, an attempt was made, in Paris, to have a monthly dinner, to which every electrician, or so-called electrician, might be admitted by paying his quota. After one of these meetings, a committee was nominated (of which the presidency was offered to the minister for post-offices and telegraphs); to study ways and means.

A centre for obtaining information as to the progress of electricity in every country, was to be established (it would seem that the French and foreign publications were not sufficient !), and electric questions investigated by mutual discussion and working together (they forget that there is a syndical chamber of electricity already in Paris), to aid in the popularization and development of the applications of electricity, by every means—periodical publications, lectures, meetings, public experiments, etc., to follow, at home and abroad, the progress of industrial, administrative, and public questions ; the utilization of natural forces that it is possible to capture, distribute, and make use of, and to encourage intimate intercourse and solidarity between all the members of the society.

Such a programme cannot, in our opinion, be carried out, the more so as the society was not to patronize any industrial or commercial enterprise. Will it busy itself with any financial undertaking ? We hope it may, for its own sake, for otherwise, where will its resources come from ? It costs pretty heavy to make new ideas succeed. The Jablochkoff candles and the Edison lamps took some millions before getting a foothold. We have only to see how matters are going on now, to be convinced that the best inventions would have little chance of success at present, without money to back them ; and yet, this society is to show a disinterestedness that would render it powerless.

Besides, what advantage could professional electricians derive from this new organization ? We are living under the *régime* of the " struggle for life," in a deluge of discoveries, and only those that have great vitality, can keep afloat ; they must have real superiority, or possess indispensable resources in men and money.

When an inventor has something, does he not know where to apply ? There are the Société Génerale des Téléphones, La Compagnie L'Eclairage Electrique, La Compagnie Electrique, and a number of well established companies in England and France, all disposed to receive and examine anything. What more could the society, whose programme we have given, do in such a case ? Candidly speaking, the want for such a society has not yet been perceived.

Perhaps I could not better show the difficulty that electric companies meet, in maintaining themselves, than in analyzing the reports presented at the general meetings of the companies that have been formed in France for working the Edison patents The financiers that accepted the mission of vulgarizing the inventions of the celebrated American on the Continent, formed the idea of establishing three companies, apparently distinct, but really very closely united by common interest. Now, why were there three societies, instead of one ? This is the secret of the founders, and we will not try to discover it. *La Société Industrielle & Commerciale Edison*, with a capital of 1,500,000 francs, is specially engaged in manufacturing lighting apparatus. The *Société Electrique Edison* devotes itself to trials and experiments, temporary fittings up—in fact, to working the patents. Its capital is one million francs.

La Compagnie Continentale Edison confines itself to selling royalties and creating local companies, principally outside of France ; its capital is one million francs.

The charter of these three companies dates from February 17. 1882.

Société Industrielle & Commerciale.—The balance sheet of the first fiscal year shows a profit of 68,714 francs, 57 centimes, arising from : 1, From interest on invested funds, 27,274fr., 85c. ; 2, 14,999fr., 81c , from a share in the *Société Civile* of the Edison workshops ; 3, 26,439fr. 81c from profits of manufactures

It must be stated, however, that under the title of the cost of fitting up, the sum of 178,151fr. 27c. has been made to figure among the assets ; out of this sum, 84,055fr. 60c. are put down to general expenses, and some 30,000fr for models, drawings, fittings up of lamp factory, etc., expenses which it would be more reasonable to see placed to the account of profits and loss.*

If we lay aside this debatable question of book-keeping, we find that, according to the balance sheet, out of a capital of 1,500,000fr. there have been expended :

	Fr.	C.
In real estate	230,115	71
In manufacturing material and furniture	585,128	23
In raw or manufactured articles	426,138	77
A total of	1,231,382	71

And that the debtors' accounts represent only 102,354fr. 64c., while the creditors' accounts rise to 175,976fr. 35c. There remains, therefore, some two hundred thousand francs at the disposal of the company as a working capital—a sum that, it is needless to say, is insufficient.

The property whereon the Ivry factory is built, belongs, in the proportion of two-thirds, to the Société Civile of the Edison factory, and only for one-third to the *Société Industrielle & Commerciale.* By this means, it was possible to avoid giving up one-half the stock capital for the purchase of land and buildings.

Société Electrique Edison.—The fiscal year is said to show earnings to the amount of 15,009fr. 35c., which appears ridiculous for a capital of one million. What is peculiar in the report, is the account of customers and debtors, which figures among the assets for 578,558fr. 55c., of which sum 213,614fr. 10c. are due by the Compagnie Continentale Edison on account of the cession made to it of several properties (grounds, machines, etc.). The Société Electrique has, besides, some 320,000 francs at its disposal, but it owes various creditors 125,213fr. 65c. The remainder of its assets is represented by the material and fixtures, rents paid in advance, etc., all to the amount of 240,000 francs. The cost of *material* reached the sum of 982,634fr. 25c., and the general cost of management, working, etc., to 216,677fr. 40c , for a period of scarcely ten months. It is true, however, that the Société bore a portion of the cost of the electric exposition, and of the opera experiments. Among the permanent or temporary introductions of the company, we must cite : The shops of the Bon Marché, the powder works of St. Chamas, the Strasburg station, the bank of France, the house of Hachette & Co. In common with the *Compagnie Continentale*, it put up fixtures in 110 establishments, including 158 dynamo-electric machines, capable of working 20,000 lamps.

Compagnie Continentale Edison.—The board of managers have acknowledged a loss for this fiscal year, of 327,955fr. 50c., of which 159,915fr 25c. are to the account of the electric exposition, and the experiments at the opera; 73,775fr. 45c. for defense of patents, fees, fittings, &c.; and 99,260fr. 80c. for general expenses. The expenses for permanent fixtures, furniture and *material*, foot up a total of 352,591fr. 50c , and the credit side shows a balance on hand, and in bankers, outstanding bills, &c., of 530,360fr. 70c., with liabilities of 217,370fr. 10c. The company has, therefore, only some 300,000fr. as working capital.

It must be stated that the company has treated, since the first of January, 1883, with Messrs, Siemens & Halske, for the German patents, and received, according to the report of the managing board, 210,000 marks (262,500fr.) on account, for future fees on every lamp sold, and every dynamo put up for the production of incandescent lights. It will also have a share, to the extent of 12 6 per cent., in all the profits of the German company over the payment of interest on the capital paid in. This, however, is not enough to make up the deficit on the first fiscal year, but favorable results are expected from Italy, Russia and Holland, as central stations are being put up at Milan, St. Petersburg, Rotterdam and Amsterdam.

Everything stated, so far, refers to the year ending Dec. 31, 1882. Since that time we should be rather embarrassed, if asked whether things (except as regards the treaty with Siemens & Halske) had been sensibly changed. The only conclusions that can be drawn from the balance sheets, or reports, is, that the stock capital of each company is insufficient, and that it would have been better, perhaps, to have only one company, as the general expenses would be thereby reduced, and that there are no reasons to suppose that business would have been managed any worse, as we find almost the same identical names in the lists of the three managing committees.

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* **The following is the detailed account from report of council :**

	Fr.	C.
Expenses of constitution proper	16,688	50
Sundry constructions	12,534	64
Repairs and fitting up building	19,837	46
Building sundry machines	10,884	18
Models	6.209	18
Drawings	9,451	11
General expenses, from Feb. 17 to Aug. 1	84 055	80
Expense of establishing lamp factory	10,169	96
Construction of a telephonic line	8,736	45
Gratuity to M. Batchelor	4,584	00
Total	178,151	27

The Paris municipal council has given its adhesion in favor of the metropolitan subterranean road and steam traction. It seems to me that this council has not appreciated at its just value the advantages of an electric railway, especially in certain districts, where no reasonable objections can be urged against an elevated road. There were ample opportunities for forming an opinion of the system from the satisfactory results in Berlin, and at Portrush, in Ireland. A bid was put in by Messrs. Boistel, Chabrier &-Charton, civil engineers, but it did not meet with a favorable reception. It is only justice, however, to mention it.

An elevated electric road would be made on the outer boulevards, between La Villette and the Place Clichy, a distance of 3,077 metres (about 2¼ English miles), with nine stations, separated by some 350 yards The service was to be done by single cars, passing up and down every two minutes.

The minimum height of the elevated is fixed at 4.75 metres (16 feet 4 inches) above the ground, but owing to the irregularities of the surface, the height is in some places 35 feet; and the slope on the gradients is over $\frac{20}{1000}$; the radii of the curves are not below 300 metres (328 yards).

It was supposed that the distance from one end to the other would be made in twenty minutes, and that trips between the two stations would be made in the same time, thus doing away with any danger of accidents. As the work required for the traction of the vehicles, weighing some 8,000 kilos, reaches 14½ horses on gradients, while it does not exceed six horses on the greater part of the line, the use of rails as conductors has not been adopted. The line has been divided up into sections, each receiving the necessary current from the central station. In this way, the working of the road may be carried out economically. At one time it was intended to have the shops in the neighborhood of the *Chemin de fer du Nord*, where locations can be had at very moderate prices. The viaduct would be something like those of ordinary roads, and would be made of sheet iron beams, braced and fastened by iron columns.

It is a matter for regret that this project has not received any encouragement from the authorities; it possesses the double merit of applying metal roads and electricity—that is to say, the two elements that are requisite for an economic solution of the question of a Parisian railroad. The subterranean line does not take into any account all the difficulties that will be met with in the excavations, and that will upset all the estimates in the original plans. As the municipal council, on the other hand, did not accept the opening of highways with mason work viaducts, as have been made in Berlin, we can only discern in all this that the metal is well adapted for putting up the street construction, and that electricity will surely provide us with a safe and silent means of transit.

PH. DELAHAYE.

PRACTICAL TELEPHONY.

(*Continued from page* 198.)

GALVANOMETERS.—The kind most in use are known as detectors, in which the needle hangs vertically, the lower end being weighted. As, however, it is at times more convenient to use the instrument on its back, dial upwards, it is preferable that the needle be kept to zero by a small directing magnet, instead of the end of the needle being weighted. Its position is then of no moment, and the magnet may also be removed, whereby the sensitiveness of the instrument is much increased. When the magnet is removed the instrument must be turned till the needle points to zero.

It is also an advantage to have the scale on the lower half of the dial instead of the upper, where it is frequently hidden by the brass rim that holds the glass, when used standing on the ground. These instruments should be wound for quantity and intensity, as they are usually termed, the quantity or short coil wire consisting of a single layer of thick wire, and having a very low resistance, the intensity or long coil wire being very fine, and having a resistance of 150 to 200 ohms.

It much increases the utility of this instrument if the fine wire, or intensity coils, are provided with a shunt having one-ninth of their resistance, so that only one-tenth of the current passes the intensity coils when the shunt is in circuit. A small switch must be provided to put the shunt in or out of circuit. Detectors are now made having these improvements.

In addition to a supply of detectors, each office should have a horizontal astatic galvanometer to use with the Wheatstone bridge coils, this form being much more sensitive than the detector, the needles being carefully balanced, and the holes jeweled to reduce friction.

As its needle is kept in position by the earth's magnetism, the instrument must be turned so as to bring the needle to zero.

A small magnet is usually supplied with these instruments, which can be laid on the table some distance away, either to reduce or increase the sensitiveness of the instrument, the reduction or increase depending whether the north pole of the magnet is attracting, or repelling, the internal needle; to increase the sensitiveness the position of the magnet should be such, that the needle just returns to zero after having been deflected, and yet if it be placed the least closer, it drives or repels the needle from zero.

There are numerous other forms of galvanometers, but the above two instruments are sufficient for all ordinary purposes.

It may be as well to mention that the graduation on the scale is not proportioned to the amount of current flowing, it is fairly correct up to 20°, but as the needle moves further from parallelism with the coils, the effect of the current gets less and less, and at right angles, or 90°, it is practically *nil*. As detectors vary so much, it is useless to give any table of deflections for a certain amount of current, but each instrument can be tested, and the deflection, when connected to a good cell, noted for future use (the thick wire coils *must* be used for this test, as a very bad cell will give a good deflection through the fine wire coils.

THE BATTERY.—Our remarks will be confined to the two forms that in actual use have proved to be the best for telephonic purposes. For all private lines and the batteries at exchange, subscribers' premises the prism form of Leclanché (No. 2 size) is the best. The number of cells used is usually four. The ringing battery at exchanges should consist of at least six cells, and each table should have a separate battery. The following is a description of this battery, with instructions for maintaining it in good order:—

The negative element of the old form of Leclanché cell is composed of a carbon plate, placed in a mixture of coarsely powdered peroxide of manganese and carbon, the whole contained in a porous cell. The positive element consists of amalgamated zinc. The exciting liquid is a solution of sal-ammoniac. The solution has no chemical action either on the zinc or the peroxide of manganese so long as the cell is not at work. This is a great advantage; but the cell with the porous pot offers a rather high resistance, and the late M. Leclanché had for some time past been experimenting with a view to improvement. This he succeeded in effecting in the agglomerate form of cell by substituting movable plates for the porous pots. The materials used to form the depolarizing plates are, in course of manufacture, submitted to a pressure of several tons, and, when joined to a carbon plate, compose the negative element of the cell. To fit up the agglomerate cells, place against each side of the carbon plate an agglomerate block, and stretch over them the two india rubber bands. These bands have each a solid part through which a hole has been bored to receive the zinc rod. By this means the zinc is kept from touching the negative element, thus avoiding injurious local action, the whole is held firmly together, and is ready to be placed in the glass jar.

The following quantities of sal-ammoniac should be used to charge the battery; For a No. 3 (small size) cell, 4oz.; for a No. 2 (medium size) cell, 6oz; for a No. 1 (large size) cell, 10oz. In each case the cell should be filled with water so as to cover the agglomerate plates. If the cell is required for immediate action, the solution, mixed in the above proportions, should be prepared before being poured into the cell. The advantages of the new cell with agglomerate plates (as stated by the manufacturers) may be enumerated as follows:—

1. A much better use is made of the depolarizing power of the manganese, as the reduction of it is more complete than in the porous pot form, where the manganese while being reduced clogs and prevents the action of the battery long before the whole of the manganese is reduced.

2. In consequence of the readier reduction of the manganese, the carbon plate is more rapidly depolarized than with the porous pot form, and consequently the electromotive force is more sustained.

3. The resistance is *extremely constant*, whatever the electro-chemical work done by the cell may be, and will even tend to decrease in consequence of the formation of chloride of zinc, which is an excellent conductor.

4. The battery is ready for use immediately on charging, because the liquid is brought into direct contact with the negative and positive elements.

5. The renewal is exceedingly simple. When the battery becomes exhausted, the depolarizing plates, which are joined to the carbon plate, have only to be removed and fresh ones substituted.

6. By avoiding the use of porous pots the risk of breakage and deterioration is very much lessened, and the cost of renewal considerably reduced.

7. The trouble and cost of maintenance are next to nothing.

The Leclanché batteries are connected up like all other batteries—that is, the carbon of the first cell is left free, and the zinc is connected to the carbon of the second cell, the zinc of which is connected to the carbon of the third cell, and so on to the last cell, the zinc of which remains free, as shown in a future diagram of connections. When the two poles of the Leclanché battery are brought together, or, in other words, when the battery is at work, the solution of chloride of ammonium (sal-ammoniac) is decomposed, and an oxy-chloride of zinc is formed, which is soluble in the surrounding liquid. The hydrogen and the ammonia go to the negative element, and are absorbed by the peroxide of manganese.

It is important that pure sal-ammoniac be used, as the impurities found in ordinary sal-ammoniac tend to cause a rapid consumption of the zinc rods.

Although the battery works well under ordinary conditions, the best results are obtained when the following precautions are taken:

1. Keep the cells in a dry place of medium temperature.
2. Rub the inside of the neck of the glass cell (if it has not been previously paraffined) with oil or tallow, to prevent the possible creeping of the salts.
3. Take care that the contacts are always clean, and that the conducting wires are efficiently insulated.
4. When through evaporation the level of the water has fallen below the top of the agglomerate plates, fresh water should be added.
5. If the liquid becomes milky or opaque, add sal-ammoniac until the liquid becomes clear again, or substitute a fresh solution.
6. Scrape the crystals off which sometimes settle on the zincs.
7. When inspecting see that no white lead is forming between the lead cap and carbon. If there is, the cells must be removed.
8. See that none of the solution gets on to the wires or terminals, it being very destructive, and rapidly causes a fault.

If care is taken in observing these precautions the battery cannot fail to give satisfaction. In exchanges where the work is very heavy the ringing battery had better consist of 6 to 8 gravity cells. These may be made as follows:—A glass jar, 10in. high and 9in. diameter, fitted with a porcelain or wood cover saturated with melted paraffine, a circular zinc ring with two projections cast on it which comes through holes in the cover, and are held in this position by pins. One of these projections is fitted with a brass screw terminal, and, lastly, an inverted funnel made from 4lb. sheet lead pierced with holes.

To charge this battery, drop copper sulphate down the neck of the funnel till it is full, then add pure cold water till it covers the zinc ring; the battery can then be joined up in the usual manner, *i e.*, the strip of lead from the neck of the funnel going under the binding screw of the next zinc ring, and so on in succession. The last lead strip and zinc ring may then be joined by a wire, so as to short circuit the battery, and left thus for twelve hours. By that time the lead funnel will be found covered with copper, deposited from the sulphate, and so converted into the copper or negative element of the cell.

The only attention these cells require is:—Keeping the funnel neck full of sulphate, occasionally taking out the zinc and scraping off the copper deposit, and drawing off, by means of a syringe, some of the solution, replacing it with sufficient water to cover the zinc. Do not shake the battery after it is once in action.

The Leclanché cells may in all cases be retained for the transmitter local cell.

Always keep batteries in the coolest possible place (provided frost cannot reach them). Therefore, the floor or a low shelf is preferable to their being placed near the ceiling. If obliged to put them in a warm place inspect more frequently.—*London Electrician.*

ELECTRICAL CLOCKS IN PARIS.

(From *L'Electricité.*)

ADMIRAL MOUCHEZ, director of the Paris observatory, has just published his annual report, from which we extract the following passages relating to the present state of the network of electric clocks in Paris:

The service, which is very ably conducted by M. Williot, comprises, at present, eight clocks in the western circuit and seven in the eastern, all regulated by electricity.

Some interruptions occurred during the year, but the causes are known. Some arise from the deterioration of the cables in the sewers, and this could be, doubtless, provided against by adopting moveable nuts to the cables and by careful inspection. Others were owing to a defective system of inspection. The regulators would have to be cleaned more frequently, and more attention given from the central office, which is placed in bad hygrometric conditions. The regulators will be placed in new underground rooms when these are ready.

Finally, certain interruptions—generally consisting in being two seconds late—are owing to the construction of the regulators, which is too delicate for the shaking motion to which the regulators are exposed in some particular places. A great improvement has, however, been made, and these accidents will be likely entirely prevented by a system for deadening the vibrations on the escapement axis.

It may be assumed from the foregoing, that the most desirable improvement at present would be the organization of a central control service, by which the various clocks could be examined from the observatory. The problem could be solved by interrupting the synchronization current from various but fixed points of the dial of the clocks, and by marking at the central office the position of these interruptions, which are reported by a receiving galvanometer for each circuit.

Although the system of control must be put in practice progressively, and within certain limits, it is to be hoped that it can be arranged satisfactorily with the assistance of Breguet's house, which is to take the matter in hands by official authority

HISTORICAL SCIENCE.

UPON THE DISCOVERY OF ELECTRO-MAGNETISM.*

BY DR. D. TOMMASI.

TO whom belongs the honor of this beautiful and fecund discovery, which, owing to its numerous and varied applications, may be justly considered as one of the most useful and brilliant conquests of the human intellect.

The majority of scientists, not to say all, unhesitatingly concede to Œrstedt, as the true and only author of the discovery of electro-magnetism, a right to the honor, which is by no means indisputably established. From the researches of Zantedeschi in the year 1859, it appears rather that the actual creator of this new branch of electricity is Romagnosi, an Italian. But even the influence of his high authority has apparently influenced no convert to Zantedeschi's conviction, and all the efforts he has made to reclaim for Italy the honor of the discovery of electro-magnetism, have, apparently, been ineffectual.

Must it, therefore, be assumed that the facts invoked by Zantedeschi, in favor of Romagnosi, are not conclusive, that his reasons are not persuasive, that patriotism leads him to exaggerate, perhaps, the merits of Romagnosi, or must we rather recognize in the delay only a matter of routine, of prejudice, or of social conservatism.

To the simple question thus presented, I have not the pretention to respond, yet, even though I be accused of partiality for my country, I can not hesitate to recognize that the arguments upon which Zantedeschi relies to sustain this theory, are by no means devoid of foundation, and am convinced that others will agree with me when they become acquainted with an article published by an Italian journal, in 1802, that is to say, 17 years before Œrstedt discovered the deviation of the magnetic needle by the voltaic current.

In the *Ristretto dei foglietti universali de Trent*, of August 3, 1802, occurs the following passage †:

"The Counsellor Jean-Dominique Romagnosi, hastily communicates to the philosophers of Europe, an experiment relative to the application of the galvanic fluid to magnetism. After having constructed a voltaic pile with discs of copper and zinc, separated by discs of flannel impregnated with an ammoniacal solution diluted with water, the author attached to the pile itself, a wire of silver, broken in different places like a chain. Afterwards he took an ordinary magnetic needle, arranged in the manner of an ordinary marine compass, and fitted in a prismatic axis of wood, and after having removed the glass cover, he placed the needle upon an insulator of glass near the pile. He then, holding the chain by the glass tube, applied its extremity, or button, to the magnetic needle. After some seconds of contact, the needle deviated several degrees from its polar position. Upon removing the chain, the needle preserved the deviated position first assumed.

"A new application of the chain caused the needle to assume always a new position slightly different, which it preserved, after being left, so that its polarity appeared to be quite destroyed. To re-establish it, M. Romagnosi adopted the following method: he pressed the edge of the insulated box between the thumb and first finger, with both hands, and thus held it for some seconds, but carefully avoided jarring it in the least. The needle then slowly recovered its polarity, not suddenly, but by successive pulsations, like those of the seconds hand of a watch. This experiment was made in the month of May, and repeated in the presence of several witnesses."

By reproducing this passage from the Italian journal, I have no intention of diminishing in any degree the merit of the illustrious Danish philosopher; but, is it not just to rescue from oblivion the name of he who first observed the action of the voltaic current upon the magnetic needle.

As I have already stated, it is not to answer this question, already discussed by Zantedeschi, in 1859, that I now revive it, but in view of the approaching exposition of electricity, in Vienna, to present it to the attention of scientists.

During the exposition there will, no doubt, be a meeting of electricians. It is my desire that they shall consider, discuss, and, if possible, definitely decide the matter. The discussion by competent men of diverse nationalities of this disputed incident, of the history of electro-magnetism, would be regarded with great interest. It would, undoubtedly, revive many forgotten facts, perhaps the names of other scientists who have also contributed to the discovery of electro-magnetism.

To resume—

1. Should the merit of having first observed the deviation of the magnetic needle, be attributed to Œrstedt or Romagnosi?
2. Did Œrstedt know of the experiment of Romagnosi when he published his discovery in electro-magnetism?
3. Were there no other scientists who took part in the discovery?

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* From "Cosmos les Mondes," June 30, 1883.

† Historie de la physique et de la chimie par Ferdinand Hoefer; page 298.

Such are the questions that I have the honor of presenting to the committee of direction of the Vienna exposition, and of asking them to present to the electricians during their approaching re-union.

DR. D. TOMMASI.

THE TELEPHONE PATENTS.

WE take the subjoined from the Boston *Herald* of July 18th:

"Two recent events have re-awakened public interest in the long discussed question as to who was the original inventor of the speaking telephone. One is the decision of the patent commissioner, reported in the Washington despatches yesterday, conceding a point to Drawbaugh, who claims to be the pioneer inventor, and whose instruments are now the property of the People's Telephone Company of New York. The commissioner's decision is very important, inasmuch as it allows of a reopening of a case in which the invention of the transmitter was in dispute, and the ruling is directly contrary to a former decision of the examiner of interferences. The other circumstance which adds interest to the question is the announcement of the simultaneous publication in this country and Europe of a book to show that the telephone was invented first by a German named Johann Philipp Reis. The author of the book is Professor Sylvanus P. Thompson, who seems to have furnished some advance sheets to William F. Channing, M. D., of New York, who, in turn, has made them the foundation of an interesting article in the current number of the *Popular Science Monthly*. At the outset, Dr. Channing holds, that beside the telephone the telegraph is a clumsy mechanism. Already the business centres expand, he says, and the values of city lands change under the magic of an invention which places every man at every other man's ear. But the doctor thinks this prophecy or promise of the telephone is not all that affects the interest of the American people There is a menace in connection with its present history which justly awakens public concern Rapacious hands have clutched the throat of the telephone, to extort oppressive tribute for every word which it utters. Dr. Channing holds enthusiastically to the idea that Prof. Thompson's book establishes beyond honest doubt or question, by historical evidence, by the reproduction of original documents and illustrations, and by the public records of scientific bodies, that Philipp Reis discovered the electric transmission of speech in 1860-'61; that he elaborately described and exhibited his telephone in 1861; that he invented transmitting and receiving instruments which not only talked then and talked now, but which include the essential principles of the transmitters and receivers now in use; and that he manufactured and placed on the market, and sold his instruments in 1863 for the purpose of transmitting electric speech and song. In the course of his elaborate claim for the German, the author of the forthcoming book indulges in an unconscious defence of Drawbaugh, when the latter is charged with not having been prior to other claimants in producing a speaking telephone. He says that between 1861 and 1864 Reis's telephone in England was the subject of experiment and improvement, and adds that it is rumored, with a good deal of probability, that his instruments were so far improved in a German neighborhood in Pennsylvania that fluent talking was obtained some years before the revival of the telephone in this country by Gray and Bell. The year 1864, according to this authority, was probably the culminating point of Reis's career in connection with the telephone. He is said to have proclaimed the invention as an accomplished scientific fact, and confidently predicted its commercial application. He died of consumption, Jan. 14, 1874, at 40 years of age. Prof. Thompson, in his book, shows in parallel columns the identity of expression between Reis and Bell in their statement of the essential principles of the telephone. The conclusion reached by the author, from the survey of the whole field, is that there is not, in the telephone exchanges of England to-day, any single telephone to be found in which the fundamental principles of Reis's telephone are not the essential and indispensable features. This conclusion, argues Dr. Channing, makes the speaking telephone, in its elementary form, free to the whole world. It opens wide the door for the future development of the telephone, he thinks, and should assure to all those who, by their genius and industry, in our day and generation, have improved or may improve it, an ample pecuniary reward. Furthermore, Dr. Channing says, in the light of historic facts which Prof. Thompson's book establishes, the decision of the courts of the United States that Prof. Bell is the discoverer of a new and useful art (the electric transmission of speech`, to which he has exclusive title, must be reversed as speedily as possible, that our courts may retain the respect of the people of the United States.

"One of the officers of the People's Telephone Company, the corporation which holds that Drawbaugh was the original inventor of the telephone, happened to be in Boston yesterday, and a *Herald* reporter asked him about the claim made by Prof Thompson. He answered: "If you were aware of the tactics of the Bell company you would look upon these things differently During the last few days you have seen something about patents being allowed for a McDonnough telephone. In a few days the country will find out what he has and what he claims. His claim for an early invention is absurd in view of the fact that in July, 1883, he has not got a telephone that will work The article in the *Popular Science Monthly* is inspired by the Bell company, and both that and the McDonnough claim are put forth to injure or prevent negotiations for territory, now going on between the people's company and prominent persons in the state of New York. The Reis claims have been twice decided as worthless in Bell company suits by Judge Blatchford, and were so held in the English and Scotch courts in hotly contested cases tried last year. You must remember that the Bell company has everything to lose and nothing to gain in its litigation with the people's company, while we, with the best instruments and no incumbrances, have nothing to risk in an open fight. We have formed first-class connections and have every prospect of success. Indeed, so confident are we that we shall presently go ahead and duplicate the local exchanges throughout the country in order to be ready to serve the public when the litigation is ended. We do not wish to boast or even talk of our present doings. We feel more confident than ever before. Every step in the legal proceedings hits our opponents in a vital spot."

IMPORTANT PATENT OFFICE DECISIONS.

A DESPATCH to the associated press from Washington, date of July 21st. states, that the first stage of the settlement of the question of priority of invention of the several parts of the telephone, was reached to-day when the Examiner of Interferences in the patent office promulgated his decision in "the speaking telephone interference cases." The first of these interferences, of which there are eleven, was declared in March, 1878, and the patent office has at various time since then considered them and heard arguments upon them. The parties originally involved were A. G. Bell, J. W. McDonough, T. A. Edison, E. Berliner, G. B. Richmond, E. Gray, A. E. Dolbear, A. G. Holcombe, C. E. Chinnock, C. A. Randall, F. Blake, J. H. Irwin, and G. M. Phelps. W. L. Voelker was made a party to three of the cases in 1879.

Of the original parties, decisions have heretofore been rendered against Richmond, Holcombe, Randall, Phelps, Chinnock and Berliner. The decision of the remaining eleven cases covers 348 printed pages. The several interferences are denominated respectively as interferences A, B, C, D, E, F, G, I, J, L, and No. 1.

INTERFERENCE A. The subject matter of interference A is defined as "the art of transmitting and reproducing at a distance sonorous waves or vibrations of any description, which consist in increasing and decreasing the strength of an electric current traversing a circuit in such a manner as to produce in said circuit a series of electrical waves or vibrations precisely corresponding in their intervals of relative amplitude to the sonorous waves which are to be reproduced at the receiving station or stations, so that oral conversations or sounds of any description can be telegraphically transmitted." With regard to this interference the examiner holds that the evidence shows that this art "had not been invented prior to the filing of Bell's application for a patent, February 14, 1876." Priority of invention is accordingly awarded to Bell on this count. The parties to this interference were Bell, Gray, Edison and Voelker.

INTERFERENCE B.—The subject matter of interference B is defined as "the improvement in the art of transmitting vocal sounds or spoken words telegraphically, which consists in throwing upon the line, through the medium of a varying resistance, electric impulses corresponding to the vibrations of a diaphragm operated by the movements of the air produced by a spoken word." The parties to this were Bell, Gray, Edison and Voelker. The examiner holds that while "Gray was undoubtedly the first to conceive of and disclose the invention, as in his caveat of February 14, 1876, his failure to take any action amounting to completion until after others had demonstrated the utility of the invention, deprives him of the right to have it considered as a continuous act." He holds that it is not proved that Edison possessed a knowledge of the art or method prior to June 25, 1876, when Bell had reduced it to practice. Priority of invention in this instance is accordingly awarded to Bell.

INTERFERENCE C.—Two inventions included in interference C are thus defined:—"First, the transmitter, consisting of the combination in an electric circuit of a diaphragm and a liquid or equivalent substance of high resistance, whereby the vibrations of the diaphragm cause variations in the resistance of the electric circuit and consequently of the strength of the current traversing said circuit. Second, in a telegraph instrument operated by sound, the combination with the diaphragm of two or more electrodes placed in an electrolytic liquid, and operating to increase and decrease the resistance of the electric circuit by the movement derived from the diaphragm." In these inventions the examiner awards priority of invention to Bell.

INTERFERENCE D.—The subject matter of interference D is in "an electro hydro-telephone, the fluid holding vertically an adjustable tube, within which the ends of the platinum points are immersed." The examiner awards priority of invention to Edison, on the ground that in Edison's "exhibit water telephone," proved to have been made as early December, 1876, the first embodiment of this feature is shown.

INTERFERENCE E.—The invention embraced in interference E is defined as an acoustic telegraph "including sound producers as well as reproducers on armature plate (consisting of a diaphragm of iron or steel, an armature fastened to a membrane diaphragm, or a non-musical armature plate fastened at one end), the electro-magnet for the same, and a closed circuit passing from the helix of such electro-magnet to the source of undulatory electric energy." The parties presenting claims were Bell, Edison, Dolbear, and Gray. The examiner awards priority of invention to Bell, fixing the date of his patent as February 14, 1876.

INTERFERENCE F.—The subject matter of interference F is defined as follows:—"First, a telephonic transmitter, consisting of a coil of wire, one or more magnets and a disc or diaphragm so arranged relative to each other that a motion of the diaphragm shall induce in the coil of wire an electric motive force in virtue of the presence of the magnet or magnets; second, the combination in one circuit of two or more discs or diaphragms so arranged relatively to each other that if one of the discs or diaphragms be put in motion by the voice, by a current of air or otherwise, it shall induce a transient current of electricity in its associated coil, which current shall actuate the other discs or diaphragms in virtue of the coil and magnets associated with them." The examiner holds that Gray and Dolbear are not shown to have invented the subject matter prior to February 14, 1876, the date of Bell's patent, and awards priority of invention to the latter,

INTERFERENCE G.—The invention embraced in interference G is defined as "a telephonic receiver consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality."

The parties to this interference were Bell, Edison, McDonough, Gray and Dolbear. May, 1875, is fixed as the date of McDonough's invention, and priority of invention is awarded to him.

INTERFERENCE I.—The declaration of interference I embraces a "telephone transmitter consisting of one or more helices forming a portion of the main circuit and surrounding a core or cores maintained in a magnetic state by the inductive influence either of an electric current or of a permanent magnet in combination with an elastic inductive plate or armature which is rigidly supported at one or more of its edges, while the portion facing the poles of the magnetic core or cores is left free, so as to be capable of responding to sonorous vibrations traversing the atmosphere or other bodies." Priority is awarded to Bell.

INTERFERENCE J.—Interference J includes the "combination with an electro-magnet of an iron or steel diaphragm secured to a resonant case for rendering audible acoustic vibrations." Priority is awarded Bell.

INTERFERENCE L.—The subject matter of interference L is declared as follows:—"First, the combination is an acoustic telegraph of an electro-magnet and a polarized armature formed of a plate of iron, steel or other material capable of inductive action and a resonant tube or case. Second, the combination is an acoustic telegraph of an armature plate polarized by induction, a resonant case or tube, and an electro-magnet and circuit connections whereby reversed currents are caused to act in the electro-magnet with varying intensity proportionate to the electric waves sent from the transmitting station." The contestants were Gray, Bell and Edison. Priority is awarded Bell.

INTERFERENCE NO. 1—The subject matter of interference No. 1 is described as follows:—"A spring forming or carrying one electrode and constantly pressing against the other electrode and the diaphragm to maintain the required initial pressure between the electrode and yield to the movements of the diaphragm." The contestants were Voelker, Blake, Irwin and Edison. Priority of invention is awarded Edison.

SPARKS.

—— **THE GERMAN NAVY DEPARTMENT** has recently realized the necessity of employing electric projectors on board the fleet for signal, search, and navigation lights.

—— THE BERNSTEIN ELECTRIC LIGHT MANUFACTURING CO. have been exhibiting their system in Hartford, Ct. They propose to organize a branch of the Boston company, for the State of Connecticut, in Hartford.

—— THE ELECTRIC TOWER, at Fond Du Lac, Wis., fell down July 11th, and a piece weighing 500 pounds crashed through the roof of a saloon, demolishing a stove at which a woman was cooking, but injuring nobody.

—— ON JULY 13, Michael Peets, aged 17 years, while reading the bible in his house on the Shaker Road, six miles from Albany, was struck by lightning and killed. His clothing was stripped from his back and his flesh lacerated.

—— THE CHARTER of the McTighe Electric Light and Manufacturing Company has been filed for record in Pittsburg. The capital stock is $300,000. $30,000 has been paid in. The company have commenced the manufacture of electric machinery.

—— THE *Elgin Daily News*, Ill., reports that an electric light company has been formed at Elgin, by Mr. G. S. Bowen, that the opera house will be supplied with six lights, and that a star iron tower will be erected on Fountain Square, running skyward 150 feet.

—— A COTEMPORARY SAYS, that on Tuesday night (July 10) Harry Miner's Theatre was lit up behind the scenes and before the footlights with electric lamps of the Maxim incandescent pattern, with which the house has been fitted out by the United States Illuminating Company. This theatre is the first in the country to be completely lighted by electricity, and the managers were enthusiastic in their praises of the new feature About three hundred lamps were burning and all the effects of full and half lights on the stage were successfully obtained with the same celerity of change as is ordinarily seen in the use of gas. The current came from the company's station in Stanton Street.

—— THE *Cleveland Leader* in referring to the renewal of the Brush Company's contract for lighting the streets of Cleveland, Ohio, says:—"The light has given good satisfaction since its introduction here, and nobody can justly find fault with the manner in which the Brush Company have performed their part of the contract. The superiority of this light over gas has been fully demonstrated, and a return to the latter would surely meet with the disapproval of nine-tenths of the people of Cleveland, who naturally take pride in anything that adds beauty to the city. It has also been demonstrated, that the difference in cost between the Brush light and gas is, considering the difference in quality, but trifling."

—— *Arizona Citizen:* "A number of mining companies in Arizona Territory are about to adopt the electric light, to facilitate operations underground, as well as on the surface—notably, the Silver King Mining Company, the Howell Smelting and Mining Company, and the Conger Mill and Mining Company. At the Silver King Mine, it is proposed to use four 3,000 candle power Brush lights above ground, and two below, together with 25 small incandescent lamps. The dynamo, located near the main shaft, will supply the current descending 800 feet to the lower levels of the mine, to the arc lights and storage boxes, from which latter the Swan lamps are to be connected by small copper wires. Fixed lamps are to be suspended from the roofs of galleries, and the portable lights are to be attached to flexible conductors, for convenience of shifting. These lights are to burn continuously, night and day. In the reduction works of this company, both large and small lights are also to be used—a separate dynamo, and two storage batteries, supplying the current. The arc-light circuit, in the Silver King mine, will be about half a mile in length."

—— ON JULY 10TH, during the prevalence of one of the most severe rain and thunder storms that has visited this section for years, Mr. Jacob Berkeyhill, proprietor of the ten-pin alley, at Somerset, Pa., was bowled down by a bolt of lightning while standing in the door of Fleck's livery stable. He had on an "electric hat," which is a cloth hat with a band of wire running around the inside of the crown and a small steel plate in front and behind. The lightning struck the front plate and tore the hat into smithereens; then running down his right side stripped the clothes from that portion of his body, from the skin out, from the shoulder to the sole of his foot. A large number of small silver coin in his vest pocket was scattered about him in a circle. A ten cent piece was burned into his flesh and was picked out by the doctor.

The ring of his silver watch was melted off, and a five cent nickel was soldered into the case of it as neatly as though it had been the work of the most finished silversmith. He was picked up for dead and carried into Dr. Rouch's office when it was discovered that his heart was still beating. The doctor went to work on him, and in a short time had him restored to consciousness. Strange as it may seem, he had so far recovered this morning as to be able to walk a square, from the doctor's office to his hotel, and is thought to be out of danger. Mr. Jacob Fleck, who was standing within a few inches of him at the time, escaped uninjured.—*Washington, Pa., Reporter.*

—— A WORK VERY IMPORTANT to the commerce of New York, will be undertaken this year. That is the establishment of electric lights at Hell Gate, for which $20,000 is available. After a full consideration of the objects to be attained, and the best means of arriving at them, the Lighthouse Board has decided to erect at Hallett's Point a tower of suitable construction, 250 feet in height, and to display thereupon six electric lamps, of about 4,000 candle power each, for the purpose of thoroughly illuminating the adjacent waters. The ordinary purpose of a lighthouse is either to mark a shoal or headland, or in co-operation with another light to indicate the course of a channel. In the case of the proposed Hell Gate light, the object is to counteract the absence of daylight, and render the passage of Hell Gate as safe by night as by day. This being, to a certain extent, an experiment, whose value to commerce can only be fully determined by actual test, the board after negotiation with the owner of a plot of ground on Hallett's Point, suitable as the site of the proposed tower, received from him an offer which has been accepted. The agreement is for the lease of this ground for three years, at an annual rental of $400, with the condition that this lease is convertible, at the pleasure of the United States, into a deed of sale, the consideration being $6,000, if paid within two years, or $7,000, if deferred to the third year. This allows ample time for the testing of the proposed lights, both as to their power, reliability, and the ease secured to navigation, at the cost of the rental only.—*Herald.*

—— ON JULY 15TH, Mr. W. U. Fletcher and his two sons, Harry and Charley, aged 11 and 13 years, took shelter from the storm under a large oak tree in a field, near Middlebourne, Tyler Co., W. Va., where they were working corn. While sitting around the tree it was struck by lightning. Harry was instantly killed. Mr. Fletcher and Charley were thrown some distance from the tree. Charley was the first to recover, and at once went to the assistance of his father and succeeded in getting him in a sitting position. Mr. Fletcher soon sufficiently recovered to send the boy for help.

When it reached the spot, Harry was found dead with his clothing in shreds, while Mr. Fletcher was still helpless. He was assisted to a residence near by, and it is thought he will recover. Charley was knocked insensible, but not permanently injured.

—— MR. LYNCH, President of the U. S. Illuminating Company, is reported, by the *Electrical World*, as referring to the lights on the Brooklyn Bridge as follows: "It was some time before we were able to illuminate the bridge perfectly. At first the oscillations of the structure interfered very seriously with the lights. You know how these lamps are constructed. The carbon points—one from above, and one from below—must be exactly opposite, for the lamps to burn steadily. But the vibrations, caused by a single vehicle passing over, were sufficient to compel the carbon points to work out of apposition, and, of course, you couldn't get a steady light. Now, however, we have arranged the lamps so that they stand perfectly straight, independently of the vibrations of the bridge, and they are working almost as perfectly as if they stood on terra firma."

When asked why lamps that stand on solid ground sometimes all go out at once for a whole district, he replied, that that used to happen, now and then, during a great storm, but is very rare now. Such accidents were caused by the wires grounding.

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1. Cipher, Letter and Telegraph Code; Larrabee.—2. Incandescent Electric Lights; Du Moncel, Preece.—3. Induction Coils, how Made and Used; Dyer.—4. Hand-book of Electric Telegraph; Loring.—5. Electric Diagrams and Connections; Davis, Rae.—6. Static Induction; Gordon.—7. Electricity; Bain.—8. Electricity; Ferguson.—9. Electric Diagrams and Connection; Davis, Rae.—10. Science for the People; Miscellaneous.—11. Chemical Physics; Pynchon.—12. Telegraphy; Preece, Siverwight.—13. Electricity and Magnetism; Jenkins.—14. History and Progress of the Elect. Tel.; Sabine.—15. Electro-Metallurgy; Watt.—16. Galvano Therapeutics; Neftel.—17. Electric Testing; Kempt.—18. The Universal Telegraph; Pcisley.—19. The Electric Telegraph (law testimony); Çook.—20. The Laws and Phenomena of Heat; Cazin.—21. History of the Atlantic Telegraph; Field.—22. Electric Batteries; Niaudet.—23. Laying and Repairing of Cables; Hoskiaer.—24. Testing of Telegraph Cables; Hoskiaer.—25. Hand-book of the Telegraph; Bond.—26. Practical Information for the Telephonist; Lockwood.—27. Text-book of Electricity; Noad.—28. The Telephone; Du Moncel.—29 The Storage of Electricity; Greer.—30. Six Lectures on Various Forces; Faraday.—31. Experimental Researches in Elec., Vols 1, 2 and 3; Faraday.—32. Testing Telegraph Lines, Vols. 1 and 2 Schwarder.—33. Practical Telegraph; Culley.—34. Modern Practice of the Telegraph; Pope.—35. Incandescent Electric Lighting; Sawyer.—36. The Military Telegraph During the War, Vols. 1 and 2; Plum —37. Physical Treatise on Electricity and Magnetism, Vols. 1 and 2; Gordon.—38 Practical Telegraphy; Culley —39. Modern Practice of the Telegraph; Pope.—40. The Electrical Directory; Berly's.—41. Senate Report on Underground Telegraph; U. S. G. Report.—42. Society of Tel. Engineers and Electricians; No. 35, Vol. 10.—43. The same; No. 36, Vol. 10.—44. The same; No. 37, Vol. 10.—45. The same; No. 38, Vol. 10.—46. The same; Paris Ex. Guide.—47. The same; No. 8, Vol 8.—48. The same; No. 10, Vol. 4.—49. The same; No. 11, Vol. 4.—50. The same (double No.); Nos. 13, 14, Vol. 5.—51. The same; No. 21, Vol. 7.—52. Inaugural Address of Prof. Abel; 1877.—53. List of Members; S. T. E. E.—54. The same; No 5, Vol 11. 55. The same; No. 7, Vol 3.—56. The Galvanometer, and its Uses; Haskins.—57. Electricity and Magnetism, and their Therapeutical Relations; Bird.—58. Elementary Lessons in Electricity & Magnetism; Thompson.—59. Electric Batteries; Niaudet.—60. Electric Lighting; Du Moncel.—61. The Borderland of Science; Proctor.—62. The Electro-Mechanical System Tel.; H Graig.—63. Refining and Separating Base Bullion; N. S. Keith.—64. The Phonograph, and Memoir of Edison; F. F. Garbit.—65. The Electric Light for Industrial Uses; R. E. Crompton.—66. Practical Electric Lighting; K. Hedges.—67. On the Economical Use of Gas Engines; W. E. Ayrton.—68. Electrotype Manipulation, Vols. 1 and 2; C. E. Walker.—69. Uses of the Telephones; A. B. T. Co.

Contributions of electrical works, sent to above address, will be duly appreciated, and gratefully received by the Society.

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Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Bradford, C., Solicitor of American and Foreign Patents, 16 & 18 Hubbard Block, corner Washington and Meridian Streets, Indianapolis, Ind.

Burnap, W. H., Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q., Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Fairman, James F., Telephone, Telegraph, and Electric Light Supplies, and Apparatus, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C., Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 43 Centre Street, New York.

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RATIO of Surplus to Liabilities of the leading life insurance companies on a four per cent. basis:

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NEW YORK............	50,800,396	43,760,183	7,040,213	16.09
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PATENTS FOR JUNE AND JULY, 1883.

JUNE 26th.

279,946 Annunciator, Telephone. F. B. Hazlett, Freeport, Ill.
280,046 Car for Locomotives, Electrical Pilot. S. H. Knapp, and A. E. Adams, Danbury, Conn.
280,301 Electric Generator, Dynamo. I. Fisher, Medford, Mass.
280,039 Electric Machine, Dynamo. J. Hopkinson, and A. Muirhead, Westminster, England.
280,238 Electric Machines, Commutator for Dynamo. F. M. Brown, Boston, Mass., and C. B. Bosworth, Everett, Mass.
279,977 Electric Wire Conduit. S. Parker, Chicago, Ill.
280,154 Insulated Electric Conductor. G. S. Eaton, Brooklyn, N. Y.
280,324 Insulator and Lightning Arrester, Combined. J. E. Noble, Mulberry, Ohio.
299,934 Lamp, Electric-arc. F. S. Geil, Brooklyn, N. Y.
280,337 Lamp, Incandescent Electric. R. H. S. Thompson, Lexington, Ky.
279,929 Railway Signal, Electric. D. C. Farrington, Lowell, Mass.
280,028 Telegraphy, Duplex and Multiplex. G. W. Gardanier, Brooklyn, N. Y.
280,266 Telephone Exchange Apparatus. T. A. Watson, Everett, Mass.
280,116 Telephone Receiver, Adjustable Double. D. G. Barnard, Winslow, N. J.
280,077 Type-writer, Electrical. J. A. Parks, and G. V. Sheffield, New York, N. Y.

JULY 3rd.

280,578 Burglar Alarm Attachment for Automatic Signaling Apparatus, Electric. W. F. Chester, New York, N. Y.
280,472 Burglar Alarm, Electric. O. A. Helman, Cincinnati, Ohio.
280,521 Electric Cable. W. H. Sawyer, Providence, R. I.
280,474 Electric Cable or Conductor. L. A. F. Herrmann, Paris, France.
280,764 Electric Cables, Machine for making. E. E. and E. G. Rafer, S. Chamond, France.
280,518 Electric Conductor or Cable. J. W. Rogers, New York, N. Y.
280,677 Electric Light. F. L. Senour, New Alexandria, Pa.
280,708 Electric Machine, Dynamo. F. Bain, Minneapolis, Minn.
280,439 Electric Machine, Dynamo. R. E. Ball, New York, N. Y.
280,727 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
280,689 Gas Lighting Apparatus. J. H. Towan, Charlestown, Mass.
280,366 Insulated Electrical Conductor. T. H. Dunham, Boston, Mass.
10,351 Insulating Compound for Electric Wires (Reissue). R. S. Waring, Pittsburg, Pa.
10,350 Insulating Material for Electrical Uses. R. S. Waring, Pittsburg, Pa., and J. B. Hyde, New York, N. Y.
10,349 Insulating Wires for Electric Uses, Process of, and Apparatus for. (Reissue.) R. S. Waring, Pittsburg, Pa., and J. B. Hyde, New York, N. Y.
280,341 Lamp Carbon, Incandescent Electric. A. Bernstein, Boston, Mass.
280,709 Lamp, Electric-arc. F. Bain, Minneapolis, Minn.
280,763 Lamp, Electric-arc. Y. Rabl, Camden, N. J.
280,340 Lamp, Incandescent Electric. A. Bernstein, Boston, Mass.
280,426 Lamps, Focus-regulator for Electric-arc. W. Wheeler, Concord, Mass.
280,529 Locomotive, Electro-magnetic. S. H. Beckwith, Utica, N. Y.
280,563 Measuring Apparatus, Electrical. C. S. Bradley, New York, N. Y.
280,536 Telegraph, Fire Alarm or District. W. B. Vansise, Brooklyn, N. Y.
280,616 Telegraph Lines, Automatic Roll-call for. W. P. Harris, S. Chicago, Ill.
280,753 Telegraphy, Duplex and Quadruplex. A. Muirhead, London, England.
280,451 Telephone Call Bell. H. Clay, Philadelphia, Pa.
280,662 Telephone Central Office Switch Board. T. J. Perrin, Brooklyn, N. Y.
280,351 Telephone Switch Board. H. Clay, Philadelphia, Pa.
280,663 Telephone Switch Board. T. J. Perrin, Brooklyn, N. Y.
280,707 Telephone Systems, Automatic Indicator Switch for. G. L. Anders, Boston, Mass.
280,580 Telephone Transmitter. H. Clay, Philadelphia, Pa.
280,365 Telephonic Communication, Apparatus and System for. A. Dunand, Paris, France.

JULY 10th.

281,048 Electric Carbon. H. Frasch, Cleveland, Ohio.
281,202 Electric Circuit Breaker, Automatic. L. J. Phelps, New York, N. Y.
281,223 Electric Conductor. H. D. Rogers, New York, N. Y.
280,850 Electric Light Tower. B. F. Orton, East Saginaw, Mich.
281,052 Electric Machine, Dynamo. J. E. Giles, Hazleton, Pa.
281,049 Electric Machines, Armature for Dynamo. W. P. Freeman, New York, N.Y.
280,869 Electric Underground Cable. F. A. Smith, Macomb, Ill.
281,220 Electric Wires, and Adjusting the Wires in the same Ventilating Conduit, for. W. Hendley, Washington, D. C.
280,919 Electric Wires, Conduit for Underground. J. Du Shane, South Bend, Ind.
281,097 Exercising Apparatus, Electrical. W. T. McGinnis, New York, N. Y.
280,906 Fire Extinguisher and Fire Alarm System, Electric. C. E. Buell, New Haven, Conn.
281,046 Furnace for the Manufacture of Carbon. H. Frasch, Cleveland, Ohio.
280,933 Galvanic Battery. W. W. Karshner, Washington, D. C.
280,947 Insulator for Electrical Conductors. P. C. Ohl, Plainfield, N. J.
280,882 Liquors with Electricity, Treating Alcoholic. A. C. Tichenor, Alameda, Cal.
281,176 Measuring the Current Energy received by a Secondary Battery, Apparatus for. C. F. Brush, Cleveland, Ohio.
281,224 Mirrors, Electrically Heated. B. H. Goodsell, C. Adamson, and C. O. Hering, Philadelphia, Pa.
281,175 Secondary Battery Charging, Current Manipulator for. C. F. Brush, Cleveland, Ohio.
281,156 Secondary Battery or Electric Accumulator. E. T. Starr, Philadelphia, Pa.
281,064 Telegraph and other Wires, Conduit for Underground Lines for. W. Hendley, Washington, D. C.
281,117 Telegraph, Quadruplex. A. Muirhead, London, Eng.
281,118 Telegraph, Quadruplex. A. Muirhead and G. K. Winter, London, Eng.
280,916 Telegraph and Telephone Protector. C. C. Drake, Trenton, N. J.
280,948 Telephone Call. P. C. Ohl, Plainfield, N. J.
281,000 Telephone Receiver. J. F. Batchelor, Baltimore, Md.
280,800 Telephone Receiver. L. J. Crossley, Halifax, County of York, Eng.

JULY 17th.

281,576 Electric Light Circuits, Safety Catch for. L. Stieringer, New York, N. Y.
281,285 Electric Lights, Carbon Electrode for. J. A. Moffitt, Arlington, Mass.
281,416 Electric Machine, Dynamo. E. Thomson, New Britain, Conn.
281,353 Electric Machine, Dynamo or Magneto. T. A. Edison, Menlo Park, N. J.
281,349 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
281,350 Electric Machine Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
281,363 Electric Switch. D. P. Heap, U. S. Army.
281,351 Electrical Generator. T. A. Edison, Menlo Park, N. J.
281,345 Gas Lighter, Electric. C. H. Crockett, Boston, Mass.
281,471 Gas Lighter, Electric. W. A. Drysdale, Philadelphia, Pa.
281,452 Insulator, Telegraph. T. L. Chapman, Huntington, W. Va.
281,229 Lamp, Electric. C. M. Ball, Troy, N. Y.
281,412 Lamps, Automatic Regulator for Incandescent. E. T. & E. E. Starr, Philadelphia, Pa.
281,362 Telegraph Key, Imitation. L. H. Hart, New York, N. Y.
281,339 Telegraph, Multiplex. E. A. Calahan, Brooklyn, N. Y., and P. B. Delany, New York, N. Y.
281,249 Telegraph, Quadruplex. G. D'Infreville, New York, N. Y.
281,560 Telephone. J. H. Rogers, New York, N. Y.
281,407 Telephone, Acoustic. C. Selden, St. Louis, Mo.
281,614 Telephone Call, Individual. J. H. Cary, Boston, Mass.
281,413 Telephone Circuit. J. M. Stearns, Jr., Brooklyn, N. Y.
281,414 Telephone, Electric. J. M. Stearns, Jr., Brooklyn, N. Y.
281,613 Telephone Exchange, Automatic. G. A. Cardwell, Brooklyn, N. Y.
281,406 Telephone, Mechanical. C. Selden, St. Louis, Mo.
281,381 Telephone Support. C. T. Loring, Boston, Mass.
281,478 Telephone System and Apparatus. I. H. Farnham, Portland, Me.
281,240 Telephone Transmitter. J. H. Cheever, Somerville, Mass.
281,450 Telephones, Individual Signaling Apparatus for. J. H. Cary, Boston, Mass.
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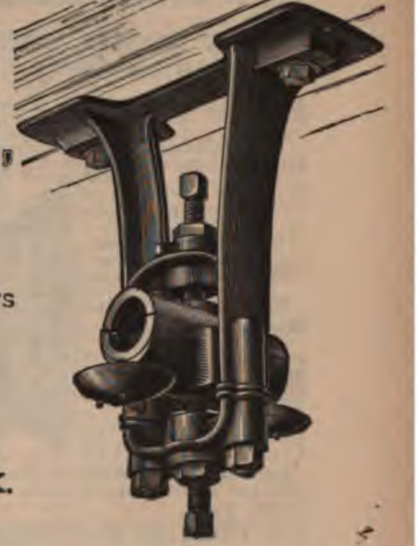

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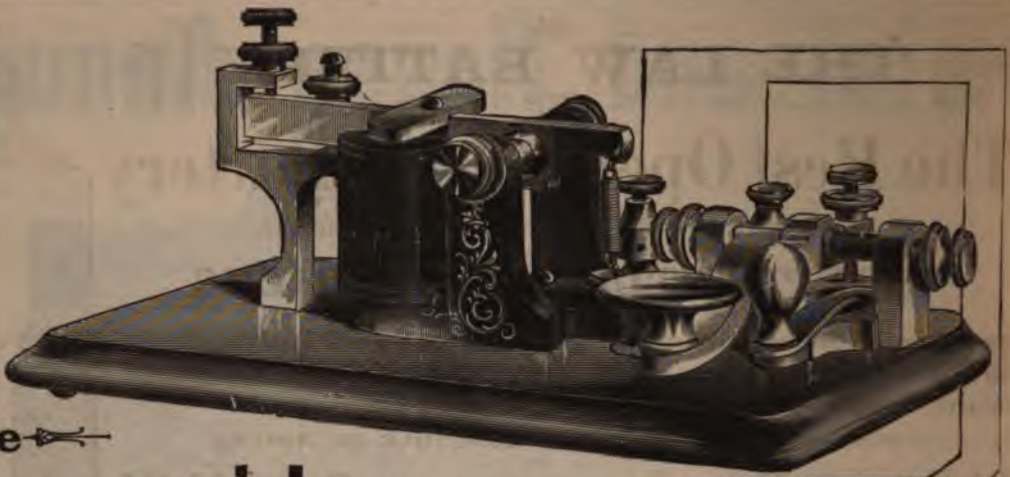

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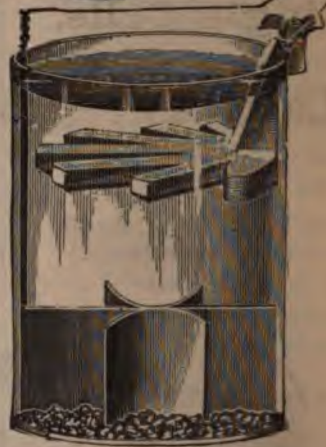

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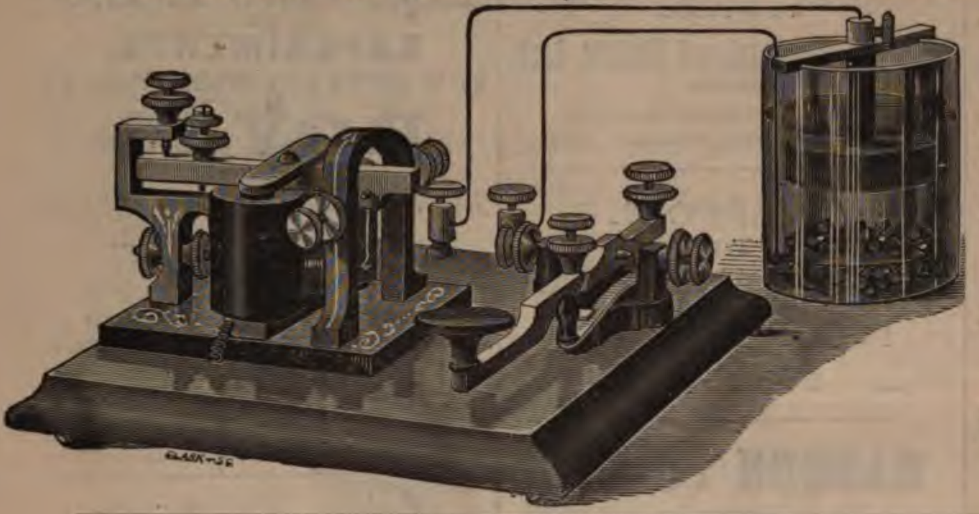

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ELECTRO-MOTORS AND THEIR GOVERNMENT.[*]

BY PROFESSORS W. E. AYRTON, F.R.S., AND JOHN PERRY, M.E.

THE near approach of electric mains being laid under our streets, and the facilities they will offer for supplying electric power during the day time to factories, workshops, and even to private houses for domestic purposes, lends an immediate importance to considerations regarding the best form that should be given to electro-motors, as well as to the best conditions under which they should be used; while the comparatively novel question as to the methods that can be employed for governing motors, so as to make them run at the same speed whatever work they may be doing, is of equally pressing importance, seeing that this condition of constant speed must necessarily be fulfilled before we can expect to see lathes, circular saws, and other tools in our workshops regularly driven by electro-motors.

The great value of electro-motors arises—

1st, from their portability, seeing that they need only be connected by means of a pair of thin flexible wires with the main supply cables.

2nd, from their small weight per horse-power developed by them.

3rd, from the possibility of their being used at a considerable distance from the prime mover.

4th, from their working to the best advantage when run fast, and so being especially suitable for driving quick-moving machinery direct, without any intermediate gearing; for in a factory there is a great loss of power arising from the friction of a long line of shafting turning in its bearings, and, secondly, there is a loss of power in the intermediate gearing employed to make the drill or other quick-moving tool revolve much more rapidly than the shaft.

The portability of motors enables us to bring the machine-driven tool to the work, instead of, as at present, the work to the tool. For example, Fig. 1 shows a circular saw directly driven by one of our motors, and which can be moved about with tolerable convenience. Again, Fig. 2 shows an emery wheel also driven by one of our motors, and which can be moved about for the purpose of polishing any large piece of metal.

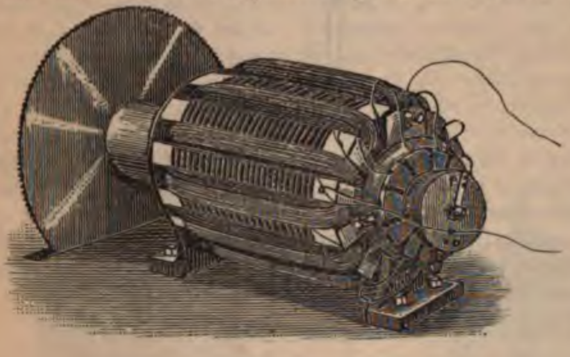

FIG. 1.

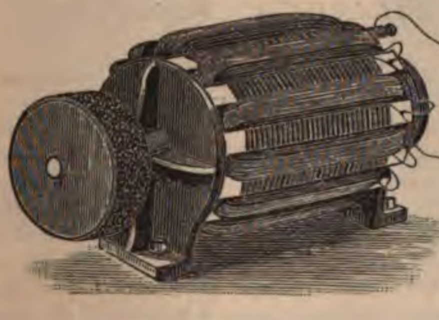

FIG. 2.

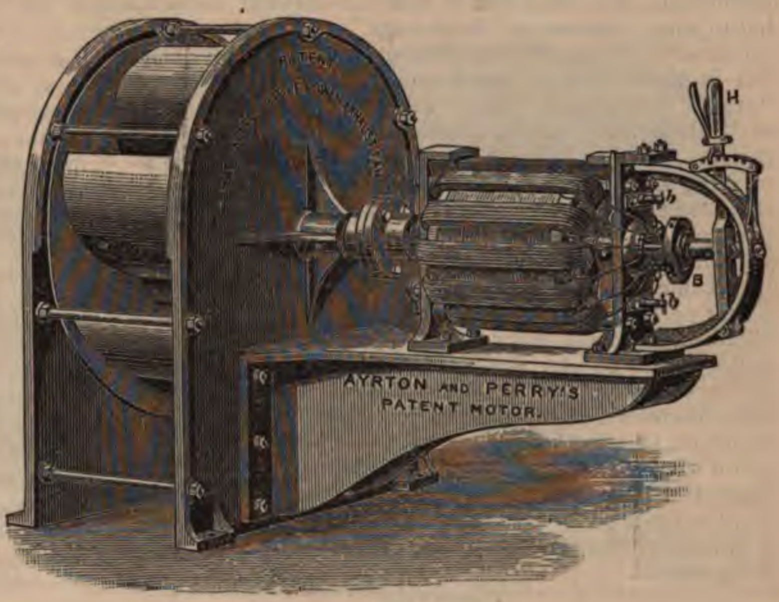

FIG. 3.

The third and fourth advantages make electro-motors of especial importance to us Londoners at this present moment.

The unsightly blow-holes on the Thames embankment, and at this end of Victoria Street, have now fallen out of favor, if they ever were in favor. Although English people are not supposed to be strong in matters of taste, we still cannot contemplate with equanimity a series of low chimneys emitting foul gases scattered along our principal thoroughfares, especially when perfect ventilation can be obtained by fans directly driven by motors. Such a fan (kindly placed at our disposal by Rev. Mr. Capell) is shown in Fig. 3, 3ft. in diameter, which is now passing 16,000 cubic feet per minute at 1,000 revolutions, and is driven by one of our motors, the electricity being supplied by Faure-Sellon-Volckmar accumulators, kindly lent us by the Electrical Power Storage Company. These fans might be stationed along the tunnel, each driven directly by a motor without intermediate gearing. A single going and returning insulated wire would convey an amount of power which seems incredible to a mechanical engineer; and a steam engine doing the work, as well as a dynamo machine supplying the electricity, might be all in some back yard out of everybody's way. The gas might be sent into the water of the Thames, and if even the bubbling up of the gas was thought objectionable, it might bubble up in recesses in the walls, so that the bubbles could not be seen. The particular specimen of our electro-motors which we are employing this evening has adjustable lead and reversing gear; this, of course, would not be necessary for motors permanently fitted and always run at a fixed speed, but it is very handy for motors when used experimentally. The details of the reversing gear can be seen from figures which come later on in this paper, where a description of the gearing will be found.

---

[*] A paper read before the Society of Telegraph Engineers, May 10, 1883.

The smaller 2ft. fan, which is being driven also by one of our motors, is passing about half the quantity of air.

The portability of electro-motors and their light weight make them of enormous importance where locomotion is involved. It may be in the memory of some of those present, that a year ago we advocated the automatic electric transport of goods and passengers by means of electric railways without engine-driver, guard, or signal-man, and we showed experimentally that the idea was perfectly feasible when our absolute block system was employed. This idea has borne fruit, for Professor Fleeming Jenkin, with his usual enthusiasm, was fired with it, and our conjoint ideas have led to what is known as "telpherage." "Telepherage," the Greek scholars among you will, no doubt, consider better, but in these days of speed and brevity, when the words "ergs," "volts," and "ohms" are tolerated, the abbrevation of "telepherage" to "telpherage" will doubtless be pardoned. We may mention that telpherage experiments on a working scale are on the eve of being tried, so that we hope that "to telpher" will shortly be a common English expression.

For telpherage, and indeed for motor-work generally, it became of immense importance to know what horse-power per pound dead weight of motor could be practically obtained, what efficiency could be relied on, and how a motor could be best governed that it was always made to go at the same speed whatever work it was doing. We have, therefore, been engaged on a long series of experiments on motors of different sizes, but before giving an account of the result of these experiments, we will consider theoretically the general principles involved in the government of motors, and exhibit one of our motors, which is governed without using anything of the nature of a mechanical governor.

GOVERNING.

A motor may be governed to run at the same speed whatever work it may be doing, in one or other of two distinct ways. 1st, the power may be cut off in proportion as the work is cut off; or, 2nd, a brake may be employed to replace the useful load removed, which brake may either waste the excess power, or store it up for future use. Hitherto the first method alone has been attempted, viz., that of cutting off the power, and usually with this very serious defect, that instead of the power cut off being directly in proportion to the work cut off, the arrangements have been such that either all power was cut off or none, so that the motion of the motor was spasmodic, just as in an ordinary gas engine, which suffers from the same defects, that full charge of gas or no charge are the usual only alternatives. A sample of an electro-motor governor of this type, and which may be called a "spasmodic governor," is shown, Fig. 4, and consists merely of a rotating mercury cup, into which dips a wire, which makes in this case contact with the mercury, and so completes the circuit when the speed is slow, but which, on account of the hyperbolic form assumed by the surface of the mercury as the speed rises, ceases to dip into the mercury at high speeds, and so breaks contact. This governor, you observe, is very erratic in its action, yet it will be found among the modern specifications at the patent office.

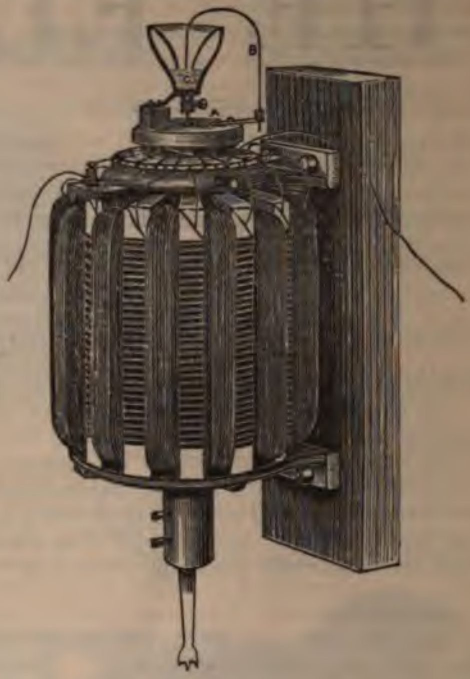

FIG. 4.

NEW COPPER OXIDE BATTERY OF MESSRS. F. DE LALANDE AND CHAPERON.

IN a recent article, in *L'Electricien*, M. Hospitalier gives the result of some experiments with the above battery.

The inventors proposed to create an energetic electric generator, constant, simple, and economic, and which would use up active matters only in proportion to the work furnished.

Owing to the selection of the materials, the battery can work on a continuous closed circuit, without any notable polarization, and almost until the materials are entirely exhausted. The transformation of the potash into an alkaline zincate, and the progressive reduction of the oxide of copper are performed without any sensible variation of the constants. We shall return to this subject after describing the principal models made by De Lalande and Chaperon.

The most simple arrangement is represented by Fig. 1. A box of sheet iron, *A*, containing oxide of copper, *B*, is placed in the bottom of a glass cup, *V*. A copper wire, insulated from the zinc by the end of a India rubber tube, is fixed to the box. The zinc consists of a cylindrical rod, 1 centimetre in diameter, which is rolled in the shape of a flat spiral, *D*, and hung from a lid, *E*, which carries the terminal, *F*; a tube of rubber, *G*, covers the upper part of the zinc, to prevent it from being cut at the level of the liquid; the cup is filled with a solution of potash, 30 to 40 per cent. This arrangement is similar to that of a Callaud element, but the depolarizer is solid and insoluble.

To avoid the annoyance of handling the potash, the quantity in the solid state, necessary for the element, is placed in the box that is to receive the oxide of copper; the box has a lid kept in place by a rubber band. All that is then necessary, is to open the potash box, place it in the bottom of the cup, and add water to dissolve the potash; the oxide of copper is then poured in from a bag. The oxide of copper is also formed from agglomerate matters. One of the best methods is to mix the oxide of copper with oxychloride of magnesium, in paste, so as to transform the whole into a thick mass that can be put in copper or iron boxes. The mass sets after a little time, its action may be accelerated by heat, and gives porous agglomerates of greater solidity according to the quantity of cement used (5 to 10 per cent.).

Fig. 2 gives an arrangement for battery, with agglomerates. The cup, *V*, is provided with a copper lid, *E*, that screws on to the glass. This cover bears two vertical sheet iron blades, *A*, *A*^{1}, and the prismatic agglomerates, *B*, *B*^{1}, are held against them by means of India rubber bands.

The terminal, *C*, which is borne by the lid, forms the positive pole. The zinc consists of a simple pencil passing in a tube, placed in the centre of the lid. The India rubber, *G*, is turned back on the tube, so as to make it water tight. The lid has besides another tube, *H*, covered by an India rubber tube that is split, so as to make a valve. The whole is closed hermetically by a rubber band, *K*, which fits on to the glass and lid. The disposition is adopted for hermetic elements, with a single depolarizing plate, and of very reduced volume.

The use of iron, copper, or sheet iron cups, that are not attacked by the generating liquid, allows the construction of elements with a large surface, and consequently a large output. The cup, *A*, Fig. 3, forming the positive pole of the battery, is of sheet iron, and brazed on the vertical edges. It is 40 centimetres in length, 20 centimetres wide, and about 10 centimetres in height. The bottom is covered with a layer of oxide of copper and porcelain insulators, *I*, are arranged in the four corners, these support a horizontal zinc plate, *D*, *D*^{1}, which rises vertically at one end, and kept at a distance from the oxide of copper, and the metallic sides of the cup, the cup is three-fourths filled with a potash solution.

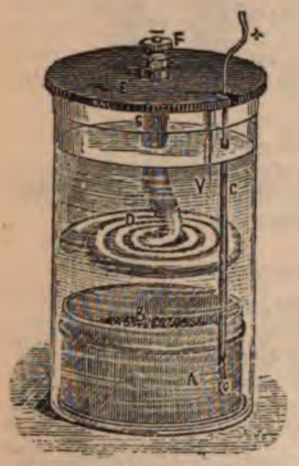

FIG. 1.—ELEMENT WITH SPIRAL.

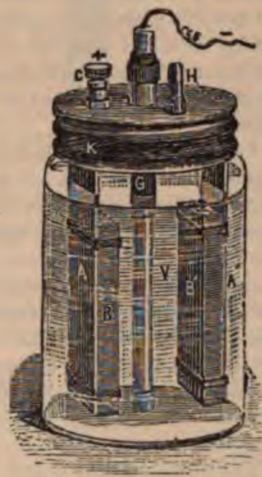

FIG. 2.—ELEMENT OF AGGLOMERATES.

The terminals, *C*, and *M*, which are respectively fixed to the iron cup and the zinc, form the poles of the battery. To avoid a too rapid absorption of the carbonic acid of the air, by the large surface of the potash solution, it is covered with a thin coat of heavy petroleum (uninflammable and odorless), or it is furnished with a cover. These elements are easily placed on top of each other, and occupy very little room. The arrangement may be varied to any extent, according to the purpose required.

Like all elements with a solid depolarizer, this new battery has the advantage of only consuming the products it contains, in proportion to its work; the amalgamated zinc, and the copper, are not at all attacked by the alkaline solution.

We made the following experiment with an element, as in Fig. 1, in the laboratory of city of Paris Escole de Physique et de chimiè industrielle. The weight of the element was divided as follows:

Glass	451	Grammes.
Cup in iron and conductor	41	"
Zinc and slate cover	419	"
Oxide of copper	200	"
Commercial solution of potash at 40 per c.	800	"
Total	1914	

The battery, the initial electro-motive power of which was, 0.98 volt an hour after setting it up, was placed in circuit during six entire days, on a resistance of 0.8 ohm, from a German silver wire. The difference of potential at the terminals was measured by Sir Henry Thompson's graduated voltmetre. Knowing the exterior resistance, *R*, and the differences of potential at the extremities of this resistance, it is easy to deduct the intensity of the current, the quantity of electricity furnished, and the corresponding electric energy. The annexed diagram, Fig. 4, shows how the intensity of the current varied during the six days working.

The current furnished was, on an average, a half ampére during six days, or 518,400 seconds, The total quantity of electricity given was 259,000 coulombs; the weight of zinc used, 88 grams, which corresponds to a theoretical production of 260,000 coulombs. This is a most important point, as it shows that the consumption is theoretical—that is, the local action is practically null. The energy that the battery is capable of furnishing is, therefore, at hand for any fraction *desired*, without any need of touching the elements to withdraw the zinc from the liquid, as, for instance, in the bi-chromate of potash batteries.

The average useful discharge is 0.02 kilogrammetre per second. The battery, therefore, gave 10,368 kilogrammetres of utilizable electric energy in the six days. This is a superior figure to the results hitherto obtained from accumulators of the same weight, but it is proper to state that the discharge is much less rapid in the case of the latter. It is also easy to increase the discharge by enlarging the *surface* of the elements, and lessening the distance of the oxide from the zinc plate The discharge then increases more rapidly than the weight, and approaches that of the accumulators.

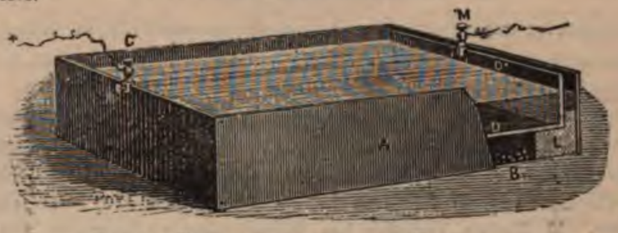

FIG. 3.—ELEMENT WITH LARGE DISCHARGE.

The element represented in Fig. 3, gives out from 10 to 15 ampéres. Our reserve is, therefore, specially applicable to the small type elements.

The remarkable constancy of the discharge must be especially attributed to the fact that the product of the reduction is good conducting metallic copper, and that the solution of zincate of potash that is formed, has a conductibility approaching that of the potash solution.

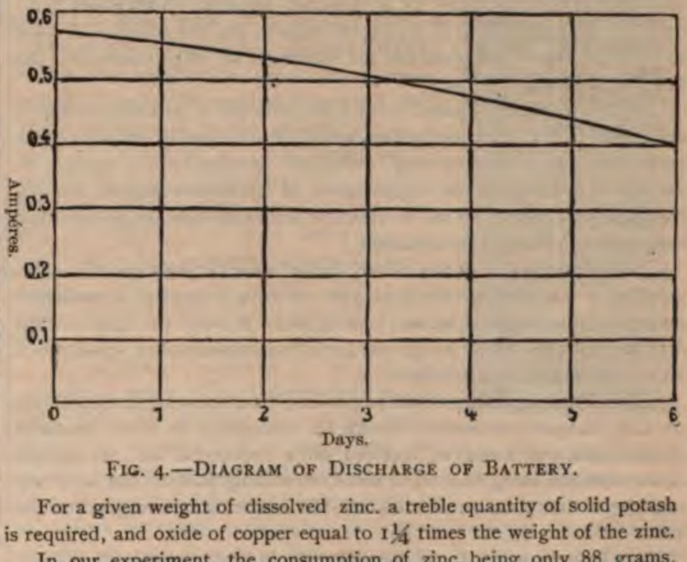

FIG. 4.—DIAGRAM OF DISCHARGE OF BATTERY.

For a given weight of dissolved zinc. a treble quantity of solid potash is required, and oxide of copper equal to 1¼ times the weight of the zinc.

In our experiment, the consumption of zinc, being only 88 grams, only 260 grams of solid potash, and 110 grams of oxide of copper were used—in fact, that the battery was only two-thirds exhausted.

The oxide of copper batteries have given interesting results in their application to telephones. For theatrical hearings, for instance, the same battery will do for the entire representation, instead of having to change four or five batteries. Three elements have worked continuously, night and day, during more than four months, Edison microphones, with carbon crayons, without any observable diminution. The only precaution necessary is to shut up the elements well, when only used at intervals, so as to keep the potash free from the action of the carbonic acid gas of the air.

Potash is preferable to soda for ordinary batteries, despite its higher price, because it does not produce, like soda, any climbing salts.

Several ways for regenerating make the battery very economical. The reduced copper absorbs oxygen, by simple exposure to damp air, and can be used again. An oxidizing screen will answer the same purpose.

Finally, by treating the exhausted battery as an accumulator, the different materials are brought back to their primitive state—the copper absorbs the oxygen integrally, and the alkali is regenerated, while the zinc is being deposited, but owing to the spongy state of the deposited zinc, it must be submitted to a new manipulation, or be received on a mercury support.

The oxide of copper, being a waste from coppersmith shops, does not lose any of its value by its reduction in the battery, the depolarization can be, therefore, considered as being done cheaply. This battery presents serious advantages as to constancy and duration, which will make it useful in new applications, without counting those where it can advantageously replace the batteries now in use.

OPTICAL TELEGRAPHY.

AUTOMATIC IMPRESSION OF DESPATCHES TRANSMITTED BY LIGHT.

BY M. MARTIN DE BRETTES.*

SELENIUM undoubtedly enjoys the privilege of attracting the attention of investigators. We know the use that Bell and Mercadier have made of it. M. P. Samuel, a little later, proposed it for registering the luminous signals given by the galvanometer with Thompson's mirror. M. Donato Tommasi has recently taken up the matter, and is trying to make a regulator out of it for the Jablochkoff candles; he, also, has briefly indicated the use that might be made of it in optical telegraphy. M. Martin de Brettes takes up the idea, and develops it in turn. We give a *resumé* of his work, stating, however, that to the gentleman above mentioned belongs the priority of the idea, if not the special applications.

Every printing apparatus requires the suitable application of power, according as the transmitter of a despatch requires. This power is reduced to the magnetizing of an electro-magnet, and the mechanical work to the attraction of the armature, the movement of which determines the function of the apparatus.

All that would be required to solve the problem of printing teleooptic despatches in the receiving station, would be, to have the projected light possess the quality of producing, during its duration (which depends on the will of the sender), the magnetization of an electro-magnet, forming part of a local battery, or an increase that would be sufficient to overcome the opposing spring of its armature.

The illumined part of the battery circuit must be, consequently, composed of a body that has the quality of suddenly becoming a conductor under the influence of light, and ceasing to be so when the light is withdrawn. There is, as we know, one body that possesses this quality in a very high degree, viz.: *selenium.*

The electric light that would be produced at a receiving station in one of Col. Mangin's projectors, would be transmitted to it in a bundle of parallel rays, and would be received on a convergent lens, the element of the selenium being fixed in its focus and making part of the local battery circuit that contains the coil of the motor electro-magnet of the receiver.

The impression of the streams of light in black, long or short lines, according to the Morse alphabet, would be made automatically with the Morse wheel apparatus. The streams of light would be sent by the simple movement of a lever displacing an obturator screen. The printing of the despatches, in printing letters, would be done by a Breguet dial receiver, the needle being replaced by a type wheel. A printing device, worked by a special battery, would be added.

The distance between two stations depends on the air and the latitude, and, everything else being equal, on the quantity of light received by unity of surface, when the luminous rays are parallel. The law governing the decrease of the intensity of light, in this case, is not known, but this decrease is solely dependent on the absorption by the air, for in vacuum the intensity would remain constant, so that the distance of two stations for a given electric focus cannot be determined *a priori*; it is a matter of experiment. However, the beautiful experiments made by M. Fizeau, for determining the velocity of light, show that the distance between two stations might be considerable with the present powerful electric lights, which are over 2,000 carcels. These experiments showed that the light of a single lamp gave a very brilliant focus of sensible intensity after having traversed 17 kilometres.

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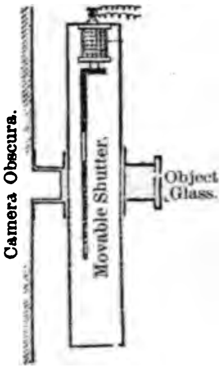
[*] From *Les Mondes.*

ELECTRIC OBJECT GLASS,

FOR INSTANTANEOUS PHOTOGRAPHING.

M. CHENUT, *Ingénieur des Arts et Manufactures*, gives the following description of the Bruno system which we here translate:

Gelatine bromide plates have been found so useful for photographic purposes that their use is becoming more general every day. The great sensitiveness of these plates render special apparatus necessary so as to reduce the time of taking, to a fraction of a second only. M. Brunot, an engineer of Amiens, has contrived an apparatus that not only gives great rapidity in opening and shutting the object glass, but also enables a distant object to be reproduced at a moment's notice, and this whether the object be in a state of rest or motion.



The electric obturator is composed of a rectangular box. On its face before the object glass, and behind, is a copper washer which works with a slight friction on a similar washer fixed on the front side of the *camera obscura.*

Inside the box—which may be more or less vertically inclined, so as to reduce or increase the time of taking—is a movable shutter bearing a soft iron armature on its upper part, and having a rectangular opening in the middle, which may be made smaller according to the intensity of the light by means of two slides that are fastened with screws.

The movable shutter is kept in place by the magnetization of a Hughes' electro-magnet, which is connected by a supple wire with two conductors, to a pocket battery that is about as large as a small box of sweets.

This battery contains asbestos soaked with bi-chromate of potash, and emits a current when a centre button is pressed, to put the zinc in contact with the bi-chromate.

The electro-magnet is weakened under the influence of the current, and lets the movable shutter fall of its own weight, or pushed by a spring. The time during which the object glass is thus uncovered is estimated at from $\frac{1}{15}$th to $\frac{1}{20}$th of a second, and this is sufficient to give an impression on a sensitive plate.

To show the rapidity with which the operation may be performed, we need only say that a very clear photograph was obtained of a train in motion, and running at the rate of 25 kilometres (15½ miles) per hour; the train was going from Amiens to Tergnier, and crossing the switches at La Neuville junction.

The smoke of the locomotive, which had been beaten down by the wind, was reproduced with wonderful truth to nature.

This obturator has the following advantages: It is completely hermetical, there is no hooking of the movable shutter, thus doing away with any shaking of the *camera obscura*, and giving more distinct images. To put the shutter in place again, and the armature in contact with the electro-magnet, all that is requisite is to give the apparatus half a revolution on the washers. A screw at the side keeps the shutter open for setting it.

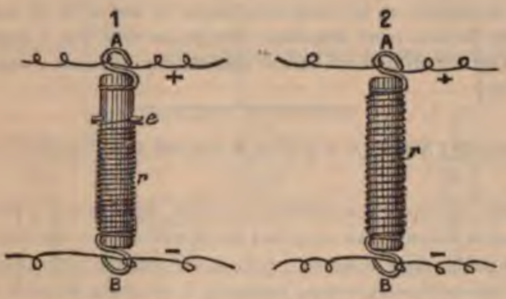
We may add that with sufficiently long conducting wires, the operator may photograph himself at a considerable distance from the *camera obscura*, or take his place among a group of persons.

ELECTRIC FIRE ALARM.

(From *La Nature*.)

THE number of electric fire alarms is already very large, as any one who visited the International Electric Exposition of 1881 must have seen, but we doubt whether among them all there were one as simple, economical and effective as that to which its inventor, M. Jules Forgeot, has given the name of *pyromenite* (fire alarmer).

A cylindrical rod of porcelain, ivory, or any other insulating matter, some two centimetres (.78 of an inch) in length, and from three to four centimetres (1.18 to 1.57 inch) in diameter, has metallic mountings at both ends. These mountings are furnished with hooks *A* and *B* where the rheophores of the battery that actuates an electric bell work are attached. When these two mountings are placed in metallic communication, the circuit being closed, the bell work is immediately put in action.



1.—Open Circuit. 2.—Closed Circuit.

FIG. 1.—THE FORGEOT FIRE ALARM.

The electric connection is made under the following conditions, and when the temperature of the place where the apparatus is placed, rises above a certain limit: A spiral metallic spring *r* is wound round the insulating rod, and rests on one side on the mounting *B*, and on the other side on a small pin *e* of fusible metal, which is inserted in a hole through the rod at some two or three millimetres (about $\frac{1}{10}$ of an inch) from the mounting *A*. When the spring is thus in tension, the circuit is open, but as soon as the fusion temperature of the alloy is exceeded (55 *C* (135 Fah.), the pin melts, the spring stretches out and touches the mounting *A*, the circuit is closed and the bell work is put in action.

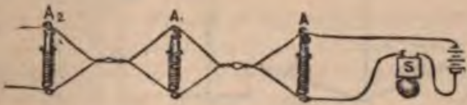


FIG. 2.—FIRE ALARMS, *A*, *A*, A_2, ARRANGED IN SERIES; *S*, BELL WORK; *P*, BATTERY.

The way to fit up one of these apparatus can be easily understood from what precedes. A series of these little apparatuses are placed in a room, etc., all connected with one another and with the bell battery by wires, which, owing to their silk covering, may be entwined together, so as to economize space. Whenever there is an abnormal temperature it will be felt at some point of the line of sentinels, and the bell work will immediately sound the alarm.

The degree of fusion may be changed by varying the composition of the alloy. The Darcet metal only melts at 94° (200 F). A high temperature might destroy the elasticity of the spring, but the electric contact would be made long before such a limit would be reached.

It is most important to have perfect contact between the end spires of the spring and the heads that receive the rheophores; for this purpose the headings and the spring itself are gilded or nickled, to prevent oxydation. Still the contact may be prevented by dust, cobwebs, etc., between the end of the spring and the adjacent heading. To avoid this, very fine goldbeaters' skin may be put around the apparatus, so as not to prevent the action of the spring. Fig. 3.

FIG. 3.—FIRE ALARM COVERED WITH GOLDBEATERS' SKIN.

The *pyromenite* was successfully tested in the senate chamber, at the headquarters of the fire department, and in the Pépinière barracks. Among the persons who witnessed the experiments were the Minister of War, Gen. Billot, Mess. Berthelot, Robin, Wurtz, whose competency in such matters is beyond question.

The foregoing will be sufficient to guide any person in fitting up such an apparatus. The number of bell works must be, however, in proportion to the size of the edifice or room, so that the precise point of danger may be recognized. The inventor has also made his apparatus a *water alarm*, for holds of vessels, cellars, etc., by simply using a soluble instead of a fusible material for the pin. The *pyromenite* then becomes a hydromenite.

RHEOSTATS.

IN certain electrical operations, and especially in electric metallurgy, a constant current has to be maintained for several hours, so that the quantity of the metal deposited, may be ascertained from the duration of the passage. Whatever battery may be employed, it gradually grows weaker from the change made by the decomposition of the liquid; this gradual weakness must be made up for by a resistance intercalated in the circuit, the strength of which must be progressively diminished. The Wheatstone rheostat is well adapted for this purpose, but it is costly, and can be economically replaced by the device represented by cut, and which is owing to M. de Combettes.

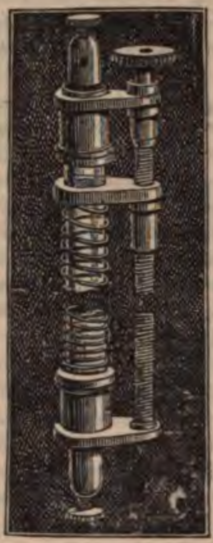


FIG. 1.—RHEOSTAT OF M. COMBETTES.

This rheostat is formed of a German silver wire, of spiral form, of indeterminate length, and gradually decreasing. The process used by M. de Combettes to obtain these spirals, is both simple and ingenious. The spiral is put in a glass tube of a slightly smaller diameter, which allows it to flatten and lengthen out in the longitudinal sense, like a spiral spring. One of the ends of this spiral, that which corresponds to the shortest pitch, is fixed to a mounting in brass, placed at the end of the tube. The other end is joined to a brass plate that presses on the spiral, and can be worked by a screw and button, to move longitudinally, and press the spiral more, or less, on itself. This movable piece establishes connection with a post by means of the screw.

In the position, as shown by the cut, the current, in order to pass from the left to the right post, has to pass through the entire spiral. It is understood, of course, that the left end of the screw is electrically insulated from the bearing that serves as a pedestal to it. When the spiral is tightened by turning the screw, the spires come successively into contact in the part where the pitch is shortest, and form a direct contact among themselves, that diminishes the intercalated resistance until all the spires are in contact. If, in the beginning of the operation, a sufficiently strong battery is used by intercalating a suitable resistance, the current can be maintained constant by working the screw,

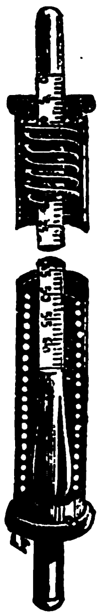


FIG. 2.—RHEOSTAT OF M. TROUVÉ.

until the rheostat gets to the end of its run. The needle can be always maintained on the same derivation, by watching the rate of the current, by means of a simple galvanoscope, and by working the rheostat.

We shall now explain an apparatus designed some years ago by M. Trouvé for the same purpose, and which seems to us to possess all the requisite qualities for a practical instrument.

It is composed of a spiral spring in German silver wire, inclosed in a tube of nickeled brass; the spires are separated from one another, and insulated from the tube by a pasteboard sheet.

There is in the inside of spring an elastic contact, formed by a metallic rod, divided into four parts slightly separated. The current arrives by the right, crosses the spiral, the contact and the graduated bar. In the figure, the rod is at the *bottom*, and the current traverses only a few spires, the resistance introduced is minimum, but when the bar is drawn, the current before reaching the contact, must traverse a number of smaller or larger spires, and, consequently, a greater or less resistance. The divisions marked on the scaled rod correspond to the number of spires intercalated in the circuit. This apparatus is applied by M. Trouvé to his *polyscopes;* it allows the current furnished by the Planté accumulator to be regulated, and to maintain the small platina wire at the desired degree of incandescence. The arrangement of the elastic split contact insures the continuity of regulation, which can be done by one quarter of a spire, which is sufficiently small in practice.—*La Nature.*

ON THE APPLICATION OF ELECTRICITY TO THE WORKING OF COAL MINES.

A PAPER was recently read before the Institution of Mechanical Engineers, in Belgium, by Mr. A. C. Bagot, the following abstract of which we take from *Nature:*

The writer described a system of electric signals, replacing the old system of signaling from the bottom to the top of the shaft by a gong worked by means of a wire. Galvanized iron telegraph wire was found to form the best communication, and the most suitable batteries to be 12-cell Leclanché. The system used for signaling in underground haulage planes, which are frequently the scene of accidents, was also described. Electricity had also been applied to signal the indications of an anemometer placed in the return air-way up to the engine room at the surface. By an arrangement of clockwork and revolving tape, the engineer obtains an automatic and continuous record of the speed of the main air current at any part of the mine. Lastly, the telephone might be applied with advantage for hearing the action of the pump valves in the pumping shaft, without having to send the sinkers down.

Electricity may, however, be brought to bear for other purposes in mines, such as illumination and transmission of power. For lighting the pit bank, powerful arc lamps are found very serviceable, and the ordinary staff of a colliery, after a week's instruction, is capable of maintaining the appliances in operation. Alternating high tension machines are very unadvisable, on account of the likelihood of accident, and the Edison low tension machine is said to be the best that can be used. At Risca colliery a cable is taken down the pit from a dynamo at the surface, and is connected with a series of Crompton incandescent lamps at the bottom. These give an excellent light, and greatly facilitate the work of the men about the bottom of the shaft. But Mr. Bagot's opinion is strongly against the use of electric lamps in the working stalls and faces; partly because such lamps do not, like safety lamps, indicate the approach of gas; partly because the line wires may be easily broken, and partly because the hewer requires to be constantly shifting his light. With regard to the transmission of power by an electric tramway, as now in use at Zankerode, the writer holds that small locomotives worked by steam or compressed air are, at present, far more economical; so that the question of electric haulage need not, in his opinion, be considered at present.

These latter opinions did not pass without challenge. M. Tresca, who was present, pointed out that there was another form of electric transmission, viz: by a fixed cable with a dynamo at each end. Where work had to be done at some special part of a colliery, especially on an emergency, he believed that this would be found a handy and economical system. At the mines of La Perronière power was thus conveyed to a distance of 500 metres, and with a useful effect of about 30 per cent. This, in spite of over-bold statements to the contrary, was about the utmost which at present could be obtained in practice. The various sources of loss in such transmission were enumerated as follows:—First, getting up the speed from that of the motor engine to that of the generator; secondly, loss within the generator itself; thirdly, loss in transmission along the cable; fourthly, loss within the receiver; fifthly, loss in slowing down the speed of the receiver to that of the main shaft. These defects were all now fully recognized, and might gradually, he hoped, be overcome. With regard to the amount of power which could thus be transmitted, the well-known experiments of M. Deprez showed 5 to 6 h. p. But within the last week he had succeeded in transmitting 31 h. p. from a Gramme machine to a great distance. The facility of installation was a great advantage in this system of transmission. It was far superior to that by an electric locomotive, as to which, at present, he had little to say; but on the whole, he was more firm than ever in the view that a negative conclusion with regard to the electrical transmission of power was at any rate premature.

MEASURING OF VERY FEEBLE RESISTANCES.

AMONG the apparatus exhibited, in 1881, by Siemens & Halske, was one of which we are surprised at not having seen any description in technical publications or works. Still, it well deserved attention from all engaged in electrical apparatus, especially from manufacturers of copper wire for electrical purposes. In fact, it enables us to measure very weak resistances (up to 1 micro-ohm), and this is a most important advantage in determining the purity of copper bars before they are wire drawn.

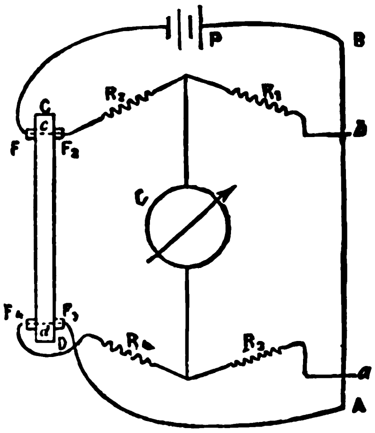


FIG. 1.

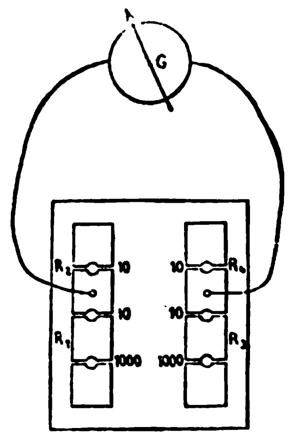


FIG. 2.

The apparatus is, in fact, a very skillful adaptation of the double bridge of Sir W. Thompson, by which the contact resistances between the bars and their connections with the instrument are eliminated.

We shall confine ourselves for the present to describe its system of working, and represent it by diagrams. Like all such apparatus of the kind for measuring feeble resistances, it is a sliding or index bridge, but the most important peculiarity consists in having the measuring bar, instead of being directly joined with the connecting wires, simply rest on two forks, which are at a certain distance (about an inch) from each other, and allow diagonal connections. The instrument gives the resistance of the length comprised between these two forks. Each of the forks is composed of two strong and massive rectangular terminals, separated by a distance of a few millimetres ($\frac{1}{25}$ or $\frac{1}{12}$ of an inch), and having their upper faces inclined at about 45°. They are beveled so as to give for contact surfaces two edges opposite to each, and between the angles of which the measuring lies.

Of the four terminals, F_1, F_2, F_3, F_4, two: F_2 and F_4 are connected with resistance coils R_2 and R_4; the third F_1 is in connection with the battery, and the fourth F_3 touches one of the ends of the divided wire, of which the other end is connected with the battery.

Fig. 1 gives a general view of the connections: *A*, *B*, is the standard wire (in German silver) stretched along a graduated rule, the resistance of which is about 0.02 Siemens unit per metre; *C*, *D*, is the bar with rectangular section, the resistance of which is sought between the lines of contact *c* and *d*, and these are determined by the position of the forks F_1, F_2. R_1, R_2, R_3 and R_4 are resistance coils, which are brought together in a single box, as seen in Fig. 2, and of which the dual relation may be varied. Two of the coils, R_1 and R_3, are directly connected with the sliders *a* and *b*, which press against the divided wire.

The battery and the galvanometer are in the positions shown in Figs. 1 and 3.

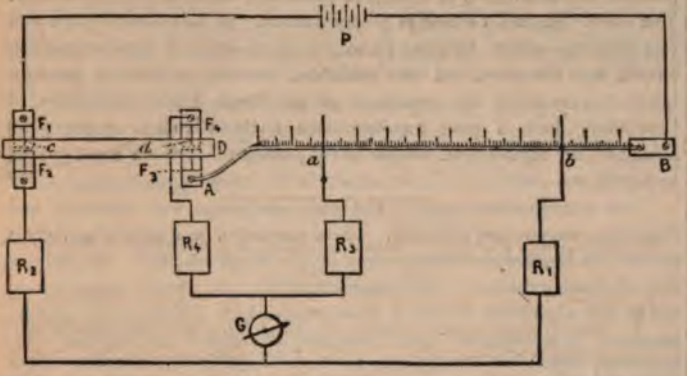


FIG. 3.

In these conditions there is an equilibrium (absence of current in the galvanometer), when we have:

$$\frac{R_1}{R_2} = \frac{R_3}{R_4} = \frac{R\ a\ b}{R\ c\ d}$$

from which we have:

$$R\ c\ d = R\ a\ b\ \frac{R_2}{R_1} = R\ a\ b\ \frac{R_4}{R_3}$$

To measure resistances from 0.01 U. S. up to 0.0001 U. S., we take:

$$R_1 = R_2 = R_3 = 10.$$

Four lesser resistances up to 0.000001 U. S., we take:

$$R_1 = 1000,\ R_2 = 10;\ R_3 = 1000,\ R_4 = 10.$$

We then adjust the position of the indexes *a* and *b*, so as to bring the needle of the galvanometer to zero.

Fig. 3 is a theoretical diagram of the bridge thus made, and when brought together and compared with Fig. 1, will show how it is that the measures of resistance taken by this system are *independent of the contact resistances* between the forks and the measuring bar.

Example—Let us suppose that we have:

Section of the copper bar = 487 square millimetres.

Distance *c d* = 30 centimetres.

$$R_1 = 1000;\ R_2\ \ 10;\ R_3 = 1000;\ R_4 = 10.$$

Position of the indexes for equilibrium:

$a = 65$ millimetres

b 10 millimetres.

Resistance of the divided wire: 0 0000208 U. S per millimetre.

We derive from this:

Resistance of the bar between *c* and *d* = 55 x 0.0000208 x $\frac{1}{100}$
= 0.0000115 U. S.

$$\text{Conductibility of the copper} = \frac{0\ 3}{487 \times 0.0000115} = 58.5 \text{ (mercury} = 1.)$$

—*L'Electricien.*

NEW ELECTRIC GUN.

M. CLAIR, a Paris engineer, has an electric gun of his invention exhibited in the Amsterdam exposition. The gun is a breech-loader, and metallic cartridges are used, but instead of having a cap, has a copper wire which runs through a wad and eye, and is connected with a platina wire. When the button is pressed, the current, which is derived from an accumulator in the stock of the gun heats the platina to a red heat, and this sets fire to the powder in cartridge. The barrel may contain several cartridges, which may be fired off successively as follows: The diameter of the platina wire of each cartridge is slightly larger than that of the cartridge in front of it, so that the thinner wire by heating first fires off the front cartridge, and the others follow in the order of thickness of their respective wires.—*La Nature*

THE TELEGRAPHERS' STRIKE.

THE strike has been of immense present disadvantage to the trade and commerce of the country, but some useful lessons have been taught the public. The gigantic power of our great corporations is more fully comprehended by the people at large than ever before, and there is a growing feeling of popular resentment accordingly. Every strike hereafter made by labor will have more significance than the strikes of the past. Again, our commercial chambers, boards and exchanges more and more believe in competition as tending to the public good. Just at this time, rival telegraph and telephone companies are being organized as a protection to those whose daily business now depends on the speediest means of communication. Beyond all this, the public, at last, has been educated to see that the National Government, by purchase or construction, should own and manage a complete system of telegraphs in every State and Territory in the Union. The American Chamber of Commerce has done much good work in aiding the promotion of legislation by congress for the establishment of the government telegraphs. The daily press, led by the *New York Herald*, has, at the eleventh hour, arrayed itself in favor of government ownership. When the chamber first proposed the plan, the press was very shy of it, and many of its present advocates were bitter opponents. Congress will, undoubtedly at its next session, pass the needful law.—*Chamber of Commerce Reporter.*

SOCIETY OF THE UNITED STATES MILITARY TELEGRAPH CORPS.

WE are requested to state that the Society of the United States Military Telegraph Corps has fixed upon the 19th of September for its Annual Reunion, to take place at Chicago, and the Old Timers have theirs on the 20th. Members of both organizations will join on the 19th in their social entertainment, ending with a banquet in the evening.

The business meeting of the Military Society will take place at 10 A. M. the 19th, and that of the Old Timers, at the same hour the 20th. The fraternity expect to have a very successful and enthusiastic meeting.

—— A CORRESPONDENT OF the *Tribune*, at Shelter Island, says:—The fact of the killing of fourteen head of cattle at this place on Saturday night by lightning, will doubtless have been recorded in the columns of your journal before this reaches you. The number is, I believe, an extraordinary one to be killed by a single stroke, and the position of the animals renders the incident still more remarkable. Instead of being closely grouped together under a large tree, they fell in two lines, together forming a V-shaped figure, 112 feet in length. Two small trees, but no large ones, were near. The bodies present no signs of being scorched or burned. Three were in a close mass at the little end of the V, where the lightning entered the earth, and all had apparently been standing, with backs to the storm.

A NOTABLE TRIBUTE.

The Société Industrielle de Mulhouse has sent to C. J. H. Woodbury, of Boston, an honorary silver medal (médaille d'argent hors concours) in recognition of his work on "Fire Protection of Mills," published by John Wiley & Sons, of this city.

This work was reviewed in the ELECTRICIAN of last September, with especial reference to that portion of the work treating of the application of the electric light. The author, as an inspector for the mill insurance companies, has had much to do with the problem of the safe use of electric light, and has written much on that subject.

By the courtesy of the publishers, we are able to give a copy of the letter accompanying the medal.

[TRANSLATION.]

SOCIÉTÉ INDUSTRIELLE DE MULHOUSE,
MULHOUSE, July 2, 1883.

SIR:—Acting upon the decisions rendered by its Committee on Mechanics at its last session, the society has awarded you an honorary silver medal for your work, "Fire Protection of Mills."

The report submitted on that occasion will appear later in our proceedings, and I will send it to you when printed. At present, I send you simply a copy of the decision. In view of the distinction received, I would submit my congratulations, and thank you for your interesting communication.

Presenting my sincere regards, I am,

AUG. DOLLFUS, President.

MR. C. J. H. WOODBURY, Boston, Mass.

P. S.—I send you, by mail, to-day the medal awarded, and hope that it will reach you in due time.

The final decisions of the report are as follows:

"To sum up, I would say that the work, which I have been charged to examine, is well executed, and full of excellent advice and information, which may have considerable value to our industries. It is essentially of a practical character, which recommends it to the study of those engaged in works of construction. The interesting matter embodied in the volume, and the skill displayed by the author in handling the subject, are such as to render it, in my opinion, worthy of an award which will direct public attention to it. I would consequently suggest presenting the author with an honorary silver medal."

THE DYNAMIC THEORY OF ELECTRICITY.

BY P. ATKINSON, A.M.

(*For the Electrician.*)

CHICAGO, August 14th, 1883.

THE dynamic theory, in its broadest sense, has been so fully tested by experiment, that it may now be accepted as *fact;* the universal order of nature, simple and perfect in its application to all phenomena where energy or force is a factor. It is briefly as follows:

Everything in the material universe, may be classified under two heads; matter, and energy or force. These two are inseparable; we cannot conceive of force in the abstract, as separate from matter; nor matter as separate from force. For the conception of matter involves the idea of mass, held together by cohesive force; and of weight, gravitating force. Hence, energy or force must be accepted as a universal property of matter.

As we can neither create nor annihilate the smallest particle of matter, so we can neither create nor annihilate force; its quantity is as fixed and definite as that of matter. And as the quantity of matter at one point cannot be increased without a corresponding decrease at another point, so any concentration of force involves a corresponding diminution.

Matter may undergo an infinite number of changes, be transmuted through ten thousand forms, from unity to infinity, and back again, without the loss of an atom; and the same is true of force. Ice may become water, steam, oxygen, and hydrogen; and so pass on through the endless list of oxides and hydrates, and back again to water and ice. So, force may assume an infinite variety of forms, and pass through endless mutations. It may appear as animal force, chemical force, gravitation, cohesion, heat, light, electricity. The gravitating force of falling water, may put in motion a dynamo machine, and be transmuted into electric force, which may move a train of cars, separate metal from a chemical solution and deposit it on another metal, send news round the world on a wire, flash out as electric light, or raise water to an elevation, to gravitate again as before.

The so-called forces of nature are not separate and independent, but are all modifications of the universal principle of force, of which electricity is simply one manifestation; having many properties in common with other forms, and, like the others, certain peculiarities which distinguish it.

If two solids are rubbed together, mechanical force is transmuted into the force of resistance known as friction. If the bodies are electric non-conductors, or insulated conductors, there soon appears that subtle form of force known as electricity. If the friction is continued, there next appears the more familiar form known as heat; continuing the friction, we have next the form known as light, and with it combustion or chemical force. Here then is mechanical force, friction, electricity, heat, light, chemical action, all from the same simple process.

Every time we light a match, five at least of these forms become apparent in quick succession; and no doubt the sixth, electricity, would be equally apparent were it not conducted away, or lost to view in the rapidity of the process.

The fact, that the various forms of force reproduce each other, is strong evidence of a common origin. Electricity produces heat, magnetism, chemical and mechanical action, and each of these in turn produces electricity.

If it be objected that sequence of cause and effect does not prove identity, the answer is that here we have more than mere sequence; we have causes producing effects, and the effects reproducing the causes. And, in the case of the match, already cited, we have at least five manifest forms of force from one common cause.

The next point claiming our attention, is the character of this form of force; is it simple, or compound? This has always been an unsettled question; two theories have prevailed, both having many able advocates. The more prevalent theory, and the one which the writer for many years maintained, asserts the *dual* nature of electricity; that it consists of two distinct kinds, positive and negative; the correlatives of each other; and that the disturbance of the equilibrium between them is the cause of all electric phenomena. That friction, induction, chemical action and other causes separate them. That like kinds repel, and unlike attract each other. And that there may be a difference of potential between like kinds, or unlike. That one body may have a higher or lower potential than another body charged with the same kind; or higher or lower than another charged with the opposite kind.

This complicated, quadruple theory is often difficult of comprehension, and difficult of application; and, if untrue, a worse than useless clog on the wheels of progress. It may account satisfactorily for most of the phenomena; and, in the infancy of electric science, when the most able investigators could only say, "We can tell what electricity *does*, but we cannot tell what it *is*," there was a reasonable excuse for accepting a theory so much in accordance with observed facts. But now that the doctrine of force, and of the conservation of energy has come to be so fully understood; when the analogy of kindred sciences points to the simple, rather than the compound theory; when the former is found to be more in accordance with facts, as verified by experiment; when it explains all the phenomena explained by the dual theory, and also phenomena difficult, if not impossible, to explain by the latter, then it is evidently more in accordance with truth, which is always simple and explicit, while error hides in mazes and intricacies.

The dual theory is never asserted of any of the other forms of force. We hear nothing of dual heat or light; dual gravity or cohesion; or dual mechanical force. It is only when we come to electricity, that this dual cobweb, in the unswept halls of science, is found; showing how much harder it is to eradicate error than to establish truth.

We may assume, then, that electricity, like heat or gravity, is a simple form of force; subject, like them, to difference of potential, and with a like tendency to resume its equilibrium when disturbed. A metal rod, heated at one point, has its heat potential at that point raised, and there is an immediate flow of heat to the colder part, or part of lower potential, which continues till the equilibrium is restored, by raising the lower potential and lowering the higher. Fill with water two vertical pipes, connected below, and it stands at the same level in each. Press it down with a piston, two feet below the level in one, and it rises two feet above the level in the other; and the force of the piston is the exact measure of this difference of potential. Decrease this force, and the tendency to equilibrium at once becomes manifest; remove it, and the equilibrium is restored.

So with electric force. Positive and negative electricity are simply difference of potential. In a large conductor, like the earth, the potential over any limited area is equal, or at zero; hence the potential of the earth is taken as the standard. Positive potential or electricity, means a higher potential than the earth; negative potential or electricity, a lower potential than the earth.

If two insulated conductors are oppositely charged, and either of them placed in electric connection with the earth, its equilibrium is restored; in the positive, by a flow of electricity *to* the earth, and in the negative, by a flow of electricity *from* the earth.

If both, while insulated, are placed in connection with each other, equilibrium takes place between them by a flow from positive to negative; and their potential will then be above or below that of the earth, that is, positive or negative, according as the original potential of either was the greater. If the negative potential of one was exactly equal to the positive potential of the other, the resulting potential would be zero, like the earth.

Let us now test both theories by one or two simple experiments.

In the familiar experiment of the pith ball, insulated and suspended by a silk thread, the dual theory holds, that when a charged body approaches, the electricity of the ball is decomposed by induction. If the charge is positive, the positive is repelled to the farther side of the ball, and the negative attracted to the nearer side; if the charge is negative, the negative is repelled and the positive attracted. But since the ball itself is attracted to the charged body, and since the action and reaction of the two kinds in the ball are equal and opposite, the attraction of the ball is accounted for by asserting that the side whose electricity is opposite to that of the charged body, and consequently attracted by it, being nearer by the semi-diameter of the ball than the repelled side, attraction must be stronger than repulsion, by the square of that distance.

When contact has taken place, the repulsion of the ball, which follows, is accounted for by saying that both are now similarly electrified, and that like electricities repel, while unlike attract each other.

According to the other theory, the attraction is due to a difference of potential. The ball being zero, and the charged body positive or negative, the ball moves toward the charged body to communicate electricity to it, if negative; or to receive electricity from it, if positive, and thus restore the equilibrium. After contact, both being at the same potential, either positive or negative, repulsion takes place.

By this theory, there is no action and reaction of opposing forces to be explained; the attraction is accounted for in a simple natural manner, fully in accordance with observed facts in regard to other forms of force. And the repulsion is also in accordance with similar repulsion in gases and vapors, whose molecules being at the same potential, are self-repellant; the repulsion increasing with increase of potential.

The charge of the electroscope, by induction, is another familiar experiment. The dual theory maintains, that on the approach of a charged body to the plate of the electroscope, the electricity is decomposed. If the charge is positive, negative is attracted to the plate, and positive repelled to the leaves, which repel each other and diverge, being similarly electrified. If the plate be now touched with the finger, while the charged body is still held near, a path is furnished to the repelled positive electricity, by which it escapes to the earth, while the negative is bound and rendered inert by the presence of the positively charged body, and the leaves collapse. If the charged body be now withdrawn, its influence on the negative of the electroscope ceases, and the leaves diverge with negative electricity. The approach, now, of a body positively charged, causes them to collapse; of one negatively charged, to become more divergent.

By the other theory, the electroscope is at zero potential; the approach of the positively charged body repels the electricity to the leaves, causing them to diverge; the plate being now touched, this induced charged passes to the earth, leaving the electroscope at negative potential, which is, obviously, the exact counterpoise of the positive potential of the charged body. Equilibrium being thus maintained by inductive action, the leaves remain collapsed. Now let the charged body be withdrawn, and the leaves diverge, being at the same negative potential, and attracted inductively by the sides of the electroscope, which are at zero. If a body negatively charged now approach, the leaves become more strongly negative, showing greater divergence; while the approach of a body positively charged tends to equalize the potential, and the leaves collapse.

It might seem superfluous to say anything about the nearly obsolete *fluid* theory, were it not that in the last revised edition for 1883, of "Ferguson's Magnetism and Electricity," a standard English work, electricity is still defined as an "*imponderable fluid.*" If it be a fluid, it is matter, but weight is a universal property of matter, hence as electricity, by the definition, is imponderable, it has no weight, and cannot be matter, and hence not a fluid. The definition then is a self contradiction, or weight is not a universal property of matter.

In brief then:—Force is a universal property of matter; electricity is a simple form of force; positive and negative are terms expressing difference of potential, above or below that of the earth, which is zero; charged bodies at the same potential repel, and at different potential attract each other; the flow of electricity is from positive to negative; a charged body is one whose equilibrium is disturbed by a change of potential, above or below the potential of the earth, and shows a tendency to resume equilibrium; non-conductors are bodies which strongly resist this tendency; conductors are bodies which feebly resist it; a discharge is the restoration of equilibrium, either between charged bodies, or between a charged body and the earth; induction is disturbance of equilibrium in a body, by the presence of a charged body insulated from it.

PHILIPP REIS.

BY H. C. BUCK, M.A.

THE long promised book, containing the life of Philipp Reis, and an account of his invention of the telephone, has at last appeared. It is a handsome little volume, and will be welcomed by thousands of eager readers. Its well-known author, Prof. Silvanus P. Thompson, D. Sc., of Bristol University, England, has shown himself, by his untiring energy, to have been admirably adapted to the difficult task.

In a conversation held with Prof. Thompson, the writer of this article observed his enthusiasm upon this subject, and the Professor remarked that, as he discovered more and more evidence of the thoroughness of Reis's investigations, and especially his broad grasp of the subject, he became fascinated with the work. It evidently was, or soon became, as has been already remarked, a labor of love.

It is understood, by the way, that the proceeds from the sale of this book are to go to the family of Philipp Reis, which consists of a widow and two children.

The writer has had the pleasure of visiting the former home of the inventor, at Friedrichsdorf, a small town near Frankfort, Germany, where Mrs. Reis still resides, and was shown many curious things historically interesting to the subject of the telephone. The binding posts still remain in the casing of the sitting room window, and also the wires connecting them with a building in the rear—over which wires, those important telephonic experiments were made, twenty years ago. Mrs. Reis, a very prepossessing and intelligent lady, said to the writer, that the constant aim of her husband was to *reproduce speech*; that was in his thoughts, day and night, and he was never satisfied with anything short of that. When, however, he saw the interest manifested by others in the reproduction of songs, etc., and also the opportunity of interesting large audiences in what he was doing, he lent his aid to that idea. Yet, a perusal of the book in question must convince any candid person that Mrs. Reis spoke the words of truth when asserting that the reproduction of music was but a side issue.

After giving a very interesting biographical sketch of Reis, Prof. Thompson describes the various apparatus (which includes no less than ten distinct forms of transmitters), and then proceeds to deal, in a very able manner, with the three following points, viz.:

I. Reis's telephone *was expressly intended to transmit speech.*

II. Reis's telephone, *in the hands of Reis and his contemporaries, did transmit speech.*

III. Reis's telephone *will transmit speech.*

Concerning the last of these statements, the writer can say, that he has often reproduced speech, including both words and unexpected sentences, using a Reis transmitter to transmit, and a Reis receiver to receive.

Moreover, the "bored block" transmitter of Reis is an excellent microphone; with any good modern receiver, talking, in ordinary tones, may readily be transmitted, even allowing the speaker to be ten or a dozen feet distant from the transmitter.

It is not claimed that the Reis apparatus was perfected, nor even made practical (any more than the telephone of Bell's '76 patent was), but it *is* claimed that Reis invented an electrical speaking telephone, and therefore (if for no other reason), the principles involved are public property.

Any "methods[*] of, and apparatus for," reproducing speech, although involving those principles, are, if previously unknown, evidently patentable.

In appendices I, and III, to this book, Prof. Thompson shows striking similarities between Reis's transmitters and receivers, as compared with recent instruments.

In appendix II, the author has done admirable work in exploding the fallacy of all that nonsense concerning "undulatory" currents, which has been harped upon so persistently. All should read the facts there stated, in full, and note carefully the remarkable similarity in the language employed by Reis, Bell, and their contemporaries, in describing the principles involved in the speaking telephone.

The following quotation has an important bearing upon these points:

"It has often been said, but incorrectly, that Reis intended his 'interrupters,' or contact regulators, to make and break the electric circuit abruptly, in the manner of a telegraphic key worked by hand. No doubt, in the mouth of a professional telegraph operator, the words, 'interrupting' the circuit, and 'opening' and 'closing' the circuit, do, now-a-days, receive this narrow technical meaning. But Reis was not a professional telegraph operator; he did not (see p. 87) even know the signals of the Morse code, and it is self-evident that he did not use the terms in any such restricted or unnatural sense as abrupt 'make-and-break,' because he proposed, at the outset, to interrupt the current in a manner represented by the gradual rise and fall of a *curve*, stating emphatically, in his very first memoir on telephony (p. 55), that to reproduce any tone, or combination of tones, all that was necessary was, to set up vibrations whose curves are like those of the given tone or combination of tones. Moreover, in the construction of almost all his transmitters, even in the very first—the model of the human ear—he purposely introduced certain parts which could have no other effect than to prevent the occurrence of complete breaks in the continuity of the current. In fact, instead of using rigid supports for his interruptor, he mounted one or both of the contact parts with springs, so that one should follow the movement of the other with a gentle pressure, never amounting to absolute break, except perhaps in the accidental case of a too loud shout. By employing these following-springs, he introduced, in fact, the element, elasticity, into his interruptor; and clearly, he introduced it for the very purpose of avoiding abrupt breaking of the contact."

The above admirably deals with the essential questions at issue. Had Reis thought a complete make-and-break desirable, he would, evidently, have made the "anvil" electrode rigid. In short, he would have made the same error which Dr. Van de Wyde did when he constructed what he termed a Reis transmitter, ***with a rigid "anvil" electrode***, and therein utterly transforming Reis's instrument, and naturally, was misled thereby. On pages 134 and 135, is the following:

"The fact that one condensation may follow another, without a rarefaction between (which Reis's curves show that he knew), must be amply sufficient to prove that, on Reis's own principle, ***his interruptor was meant to produce variations in the degree of contact in exact correspondence with the variations in the degree of pressure***, whatever these may be. Had he not meant this, he could not have talked about 'taking his stand' on the principle of representing varying pressures by an undulatory curve."

When the contents of this book are known, the two or three fallacies which underlie the famous fifth claim of

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[*] The word *methods* being used in its ordinary sense, namely, "a series of steps for accomplishing a certain end."

Bell's '76 patent, become self-evident. Mr. Bell says, therein: "I claim, as my *method* of reproducing speech, the formation of electrical currents, which vary in accordance with the variations of the sound waves which produced them."

But that is not a method of reproducing speech; it is only a method of reproducing certain electrical currents.

Bell's real method, as described in above mentioned patent, consists in the following series of steps: Sound waves, magnetism, electric current magnetism, and finally, sound waves (like the original sound waves).

Again, the method of producing such varying currents is not patentable, because any "method or process" must produce some useful end; but a varying current, *in itself*, is not a useful end.

This book, it is hoped, will serve a useful purpose in preventing any party or parties from monopolizing the reproduction of speech, "*no matter how*," as has been for so long attempted. It will also serve to do justice to the memory of one who will thereby become one of the greatest benefactors of the age.

TAFTVILLE, Conn., Aug. 12th, 1883.

Messrs. Williams & Co.:

DEAR SIRS—In Mr. Asher's article in June number of ELECTRICIAN, the machines he speaks of would attain such a high speed as to be uncontrollable, in case the electric engine should yield energy sufficient to run the magneto-engine or machine, unless a suitable electric governor was used; but, it is not probable that one hundred per cent. of power will be yielded by the electric engine, and even if it did, a small battery would be required to overcome the resistance of the connecting wires and of the heat generated in the coils. *Power* might be got in this way, from a small source. It would certainly be a big thing could it be done.

Yours very truly,

T. D. BOTTOM.

THE A, B, C, OF ELECTRICITY.

LIEUT. BRADLEY A. FISKE, U. S. N.

PART III.

AS is generally known, electric lights are of two kinds, those suitable for illuminating streets and large open spaces generally, and those suitable for interiors. The former are termed arc-lamps, because the light is caused by a vivid blaze which plays in the form of the arc of a circle between the tips of two carbon-sticks. The latter are called incandescence lamps, because the light is caused by the incandescence of a filament of carbon.

If we take two sticks of carbon, one of which is connected to the positive pole of a machine (or that part from which the current proceeds), the other stick being connected to the negative pole (or that part to which the current returns), and place their ends together, the circuit will be completed, and the current will pass between them. If, now, we draw these two carbons apart a slight distance, we shall find that we have produced the most brilliant artificial light known. The so called electric light which we see in our streets and parks is nothing but this; nothing but a blaze about a quarter of an inch long, or less, playing between the tips of two sticks of carbon, which originally touched each other, but have been drawn apart. But though the principle is so simple, and the light so easy to produce, it is not so easy to regulate its intensity. In fact, an apparatus able to do this, and to work all night in cold or heat, in snow or rain, without attention, must possess a high degree of sensitiveness and accuracy, combined with durability. The great trouble in regulating the intensity of the light comes from the trouble in keeping the carbons at exactly the right distance apart; for it is clear that, if with a light of such brilliancy, the distance between the carbons is constantly changing, or if it changes suddenly, or by too great amounts, there will arise an unbearable flickering. The principle upon which nearly all arc-lights are arranged is shown in the following sketch:

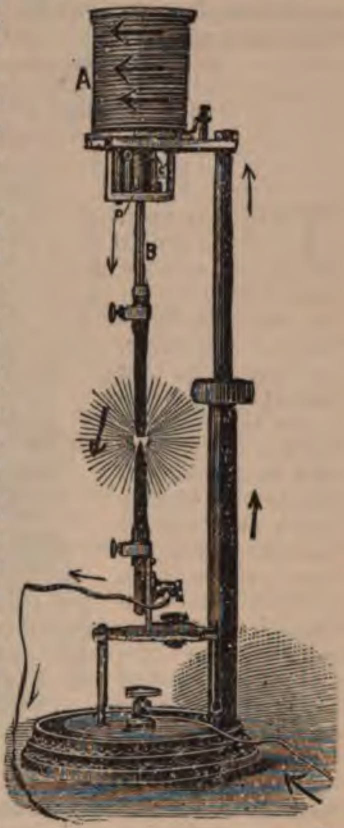


FIG. 7.

When the machine starts, the current generated passes through the electro-magnet as shown, through the carbons, and back to the machine. But in passing through the electro-magnet, it magnetizes it, and therefore causes it to draw up within it the iron rod B. This draws the upper carbon up away from the lower one. But the current jumps across the break, carrying with it some of the particles of the upper carbon, which become heated and volatilized. The gas thus produced is a conductor of electricity, so that the current has now a path from one carbon to the other; but its effect upon the gas is to raise it to a white heat. At the same time, there is so great a resistance offered to the passage of the current at the tips of the carbons, that they become incandescent. The light, then, is due to the united incandescence of the two carbon tips and the volatilized carbon particles between them. But there is greater resistance now offered to the passage of the current, than when the tips were together. This resistance has the effect of weakening the current, so that the magnet does not hold up the iron rod so far. The mechanism can, therefore, be so adjusted that equilibrium will exist between the attractive force of the current in the electro-magnet on the one hand, and the weight of the carbon on the other, when the carbons are just so far apart as to produce the desired amount of light. Suppose now that this point of equilibrium has been attained, and that the light is burning well. The combustion causes the tips of the carbons to slowly waste away, the upper one about twice as fast as the lower. This wasting away causes a greater separation, and therefore greater resistance to the current, which resistance decreases the current. The current being weaker, the electro-magnet's power upon the plunger is weakened, so that it releases it, and allows it to descend. But this action brings the carbon tips closer together which decreases the resistance and increases the strength of current; so that the electro-magnet reasserts its power over the plunger, and a position of equilibrium is again attained. In this way, the wasting of the carbons automatically causes the carbons to approach, the plunger gradually falling in the electro-magnet; and the action is so delicate, so accurate and so rapid, that, with properly constructed parts, a light placed out of the influence of gusts of air, will burn with surprising steadiness.

The incandescence lamp consists of a glass bulb exhausted of air, and containing a curved filament of carbon, about the size of a coarse horse-hair. The action of this lamp is based upon the fact that when any substance which offers a great resistance to the passage of electricity, has electricity forced through it, energy has to be expended, which appears in the form of heat. Therefore, if we place in the path of any electric current, a wire which offers great resistance to the current, the wire will become very hot; and if the current and resistance are great enough, the heat to which the wire is raised will be so great, as to appear in the form of light. After numberless experiments with materials of all kinds, electricians have finally settled upon carbonized fibre as the best adapted to the purpose of incandescence lighting on a large scale. But they found that if this fibre was raised to incandescence in the presence of the air, oxygen would quickly attack and destroy it. Therefore, it was found necessary to carefully seal the filament in a bulb exhausted of air; and such was found to be the importance of this, that a large percentage of the patents covering incandescence lamps, hinge upon methods for economically and effectively performing the operations of sealing and exhausting the glass bulb.

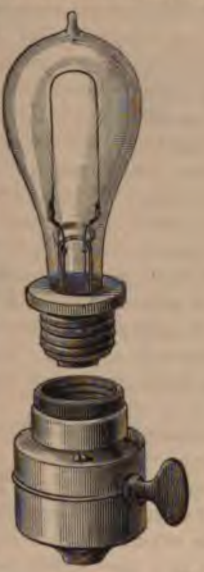


FIG. 8.

It may not be known to the general reader, that incandescence lamps, made of filaments of carbon sealed in a vacuum were made, used, and patented in England as early as 1845. The real inventor was an American named Starr, though an Englishman, named King, got hold of his idea and secured the patent. Starr died two years later, at the early age of twenty-five. His death is said to have been occasioned by overwork and disappointment. The records of his experiments bear a curious resemblance to those of workers thirty years afterwards, who have followed almost directly in his track, and, having better facilities for getting electric power, have gained fame and wealth, while Starr died in poverty and obscurity.

The incandescence lamp is ordinarily mounted upon a base, through which the wires run which communicate with the main circuit. A switch made like the valve of a gas-burner turns the current off or on. The light emitted is by far the softest, steadiest and clearest artificial light known. It possesses the further advantages, that it does not consume any of the oxygen of the air, and does not give out any perceptible heat or smell. These qualities make it obviously desirable for theatres and crowded places, as well as for private residences.

But besides supplying our cities with light, it is also the aim of electricians to supply them with power to do a score or more of the different kinds of work done in cities, this power being furnished through the agency of what are called "electro-motors."

These useful little machines may be said to be the converse in action of dynamos. A dynamo machine, it will be remembered, receives a rotary motion from a mechanical source, and produces electricity; now an electro-motor receives electricity, and takes up a rotary motion in consequence. A dynamo, in other words, converts mechanical energy into electrical energy, while an electro-motor converts electrical energy into mechanical energy.

A good illustration of the reciprocal action, on a small scale, of the dynamo and the electro-motor, is found in Bell's telephone; in which the transmitter, being made to vibrate by the voice, generates an electric current, thus acting like a dynamo; while the receiver converts the electrical energy of this current into mechanical energy, thus acting like an electro-motor.

An electro-motor as ordinarily considered, however, has a rotary motion. This rotary motion may obviously be imparted to any kind of machine. An electro-motor attached to a sewing machine, for instance, will set the fly-wheel revolving, and so will set the needle to vibrating, without the need of working the treadle. Applied to a printing press, it will work it just as a steam engine does, and will not require boilers and engines on the premises, with all their troublesome and disagreeable accessories. In the shops of workmen, it will turn their lathes; in large stores, warehouses and other buildings, it will work the elevators; in warm weather, it will turn ventilators. In fact, there seems hardly a limit to the usefulness of the electro-motor.

A general idea of the appearance of an electro-motor may be gathered from Fig. 9. The wires are fixed to the posts *a*, and when the key is turned the current enters, and a rapid revolution at once ensues. By putting a belt on the pulley, this motion may be communicated to any suitable machine near by.

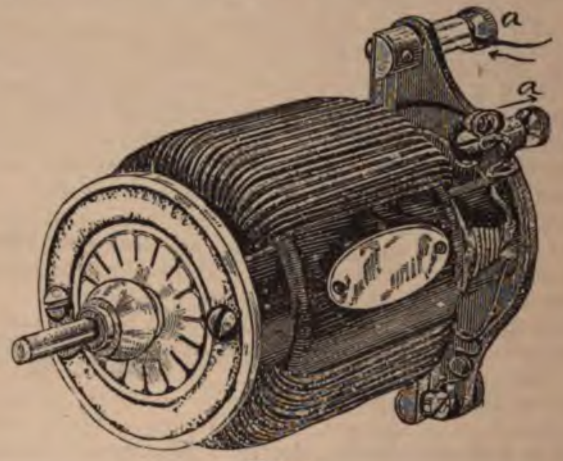


FIG. 9.

In any general system of distribution, it is intended to have not only lamps, but the motors in circuit. Ordinarily, the lamps only would be used by night, and the motors by day. Two large wires or mains, from the machine, will run under the streets. At each house two wires will extend from the mains, and from these wires the lamps and motors for that house will be fed. The great trouble with such a system as this is, that the mains will have to carry such an enormous current, that they will have to be very large. Now, as the only suitable material for conveying large currents is copper, and as copper is very expensive, it is clear that to construct mains of that material, large enough to supply an extended district, would necessitate an outlay so great as to form one of the largest items of cost in the whole plant. To get over this difficulty, accumulators, or storage batteries, are to be tried by a prominent company.

The storage battery, about which so much has been said and written of late, may be briefly described, as two lead plates standing in acidulated water. When an electric current is passed between these two lead plates, first in one direction, and then in the other, a chemical action takes place, which results in oxidizing strongly one of the plates. When, now, the two plates are joined by a wire, a current will pass from one to the other, just as in an ordinary battery. After awhile, however, this current will cease, owing to the fact that the effect of this current is to undo the work of the current which charged it. The only thing necessary to do now is to send the charging current through again, and the battery will again be found capable of generating a current. From this very general description the reader will see that it is not scientifically accurate to say that electricity is stored; but that it is more accurate to say that the electrical energy of the current is converted into chemical energy, which can be re-converted into electrical energy when desired.

In order to use accumulators for supplying lamps and motors on a large scale, it is intended to place a group of them in or near each house, each house receiving its supply from the group of accumulators placed in it; and to put the groups of accumulators one after another on the circuit of a long wire, which runs from a dynamo machine at a central station, through each group of accumulators in succession and back to the machine. On now starting the dynamo, the current generated will traverse all the groups of accumulators, and charge them. The accumulators being charged, a person in a house desiring to use a sewing machine motor or a lamp, has merely to turn a key, and motion or light will at once result.

In the torpedo, we utilize the same property of the electric current as in the incandescence lamp, *i. e.*, its property of heating a conductor which resists its passage. As usually made, a torpedo may be said to be a water-tight vessel into which run two wires connected to a battery, the two wires being joined by a bit of platinum wire, which becomes intensely heated when a current passes. The platinum wire being surrounded by gun cotton and this by powder, it will be clearly seen that on closing the circuit on shore, the gun cotton is ignited and therefore the powder surrounding it.

But probably the most important use which electricity will serve in the future will be that supplying the place of coal. The question so often asked "what will we do when the coal is all used up?" can now be answered by saying "use electricity to transfer the enormous power of water falls from places where it is doing no good to man, to other places where it can do great good." The extravagant way in which we have been consuming the limited supply of coal in the earth can not continue forever; but thanks to electricity, the failure of coal supply will not now bring ruin to cities. The power hourly spent by the tons of water which fall in the countless cataracts of our country, can be used to turn water-wheels. Water-wheels can turn enormous dynamo machines. Dynamo machines can produce currents of electricity which, when conveyed by suitable conductors to our cities, will furnish them with light by night and motive power by day. That we have arrived at such a stage in electrical science, that such a thing is now possible, is hardly true. But almost daily some advance is made in this direction. It does not seem visionary then to imagine that at no far distant day, the puff of escaping steam and the smoke of burning coal, will no longer be heard and seen in our streets. Supplied from the never ceasing torrents of Niagara or the rise and fall of the tides of the ocean, cars will glide noiselessly through our streets; the machinery in our shops and factories, bright and clean, will spin quietly around; our residences free from the smell of gas will be lit with a pure and steady light from little bulbs of glass, all through the agency of the force of nature most recently discovered and controlled —that of electricity.

THE TELEPHONE CONSOLIDATION.

POSSIBILITY THAT IT WILL NOT BE CONSUMMATED.

THE unanimous votes by which the telephone companies under Lowell management voted to go into the proposed consolidation of all the New England companies was, as we stated at the time, a magnificent expression of confidence in the wisdom of the gentlemen forming what is known as the Lowell syndicate. This confidence has always in the past been justified by the results, and in the present instance, had events turned out in the manner which they had every reason to anticipate, there would be no occasion for any wavering. But it is apparent from the views of many stockholders in the Lowell companies that the feeling is growing in favor of letting things remain as they are. It is argued that the consummation of the consolidation will turn the management of the Lowell properties into strange hands, and the Lowell stockholders are too well pleased with the efficient management of their officers to relish the transfer of their interests to people of whose telephonic ability they have no knowledge. Everybody knows that the local officers are hard-working men, putting in as many hours faithful work every day as their humblest employee, and, on the other hand, people hereabouts do not know whether the new management would possess similar habits of industry. Certainly, if the activity and zeal which have always characterized the Lowell officers had been as strongly developed in the rest of the parties to the proposed compact, the consolidation would by this time have been an accomplished fact.

Practically, however, nothing has been done toward completing the union, and the status of the companies remains exactly the same as before the meeting, with this important difference: The stocks of the Lowell companies have declined from 25 to 30 points since the vote was taken—a decline that means a considerable loss to everybody interested, and also means a low price for the new consolidated stock. Now the last thing in the world that the syndicate would desire would be anything that tended to weaken the confidence which has always been placed in their stocks. To say nothing of their own selfish interests as heavy owners, they have a proper pride in their work, and would not take a step that would imperil its high standing. Naturally, stockholders in the eastern properties, when they notice the drop in those securities, and the firmness of Erie, are quick to say that the reason is that the Lowell managers are to relinquish their hold on the former and continue with the latter. The contrast inclines the stockholders to insist upon the continuance of the syndicate in the management of the property they have so admirably developed. With this feeling, as we understand it, the managers are not disposed to quarrel. Their interests, and those of their stockholders, are identical, and they are too sensible to do aught that will unfavorably affect them. It is very possible that the executive committees will be petitioned not to execute the consolidation. In that event the probability is that the project would be dropped, and things go on as before. Whatever the managers might think of the prospects of the consolidation, they would scarcely care to take the responsibility of opposing an influential part of their stockholders in this matter. They will doubtless be satisfied to let the companies continue as at present, paying their usual handsome dividends in October, before which time, in spite of the general weakness of stocks, telephone properties will advance to the high quotations which their solid value commands.

If, however, as late negotiations make probable, the ticket is re-arranged, so that the Lowell syndicate are made an active influence in the direction, the consolidation will be agreed to. In that event there is little question that the new company will stand on the same high level that Lowell companies have always occupied.—*Lowell Courier*, Aug. 23.

—— *World* states, that Superintendent Smith, of the Fire Telegraph, who has been in Pittsburg studying the underground telegraph system there, has reported in favor of adopting the plan in this city. The counsel of the department has been ordered to find out what the powers of the commissioners are in that respect. If his report is favorable, an experimental wire will be laid.

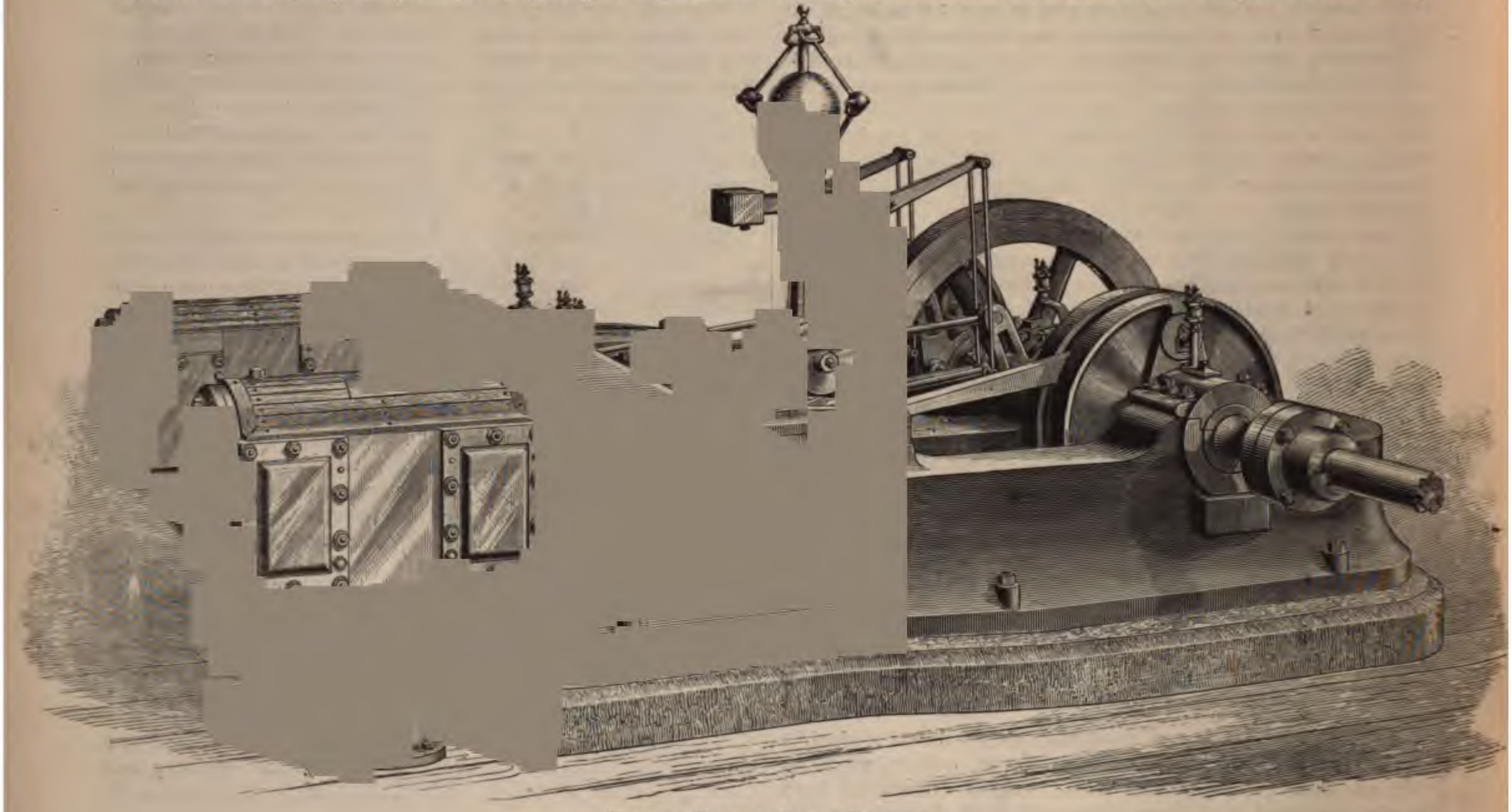
STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

IV.—ENGINES CAPABLE OF DIRECT CONNECTION.

THE PORTER-ALLEN ENGINE.

THE essentials, in the construction of the steam engine with a view to the economical production of power, as has been seen in the introductory part of this series of articles, include special provision against loss of heat and condensation of steam, at entrance into the steam cylinder, by the action of the metal surfaces to which it is exposed on all sides at the beginning of the stroke. One of the methods of securing this economy in the working of steam, has been stated to be the driving of the engine up to the highest safe velocity of piston, and giving it a maximum speed of rotation. The time allowed for condensation of each charge, and for the necessary change of temperature preceding such condensation, is thus reduced, and the amount of steam condensed being thus made a minimum, in any given time, the percentage of loss of the increased quantity of steam worked off by the engine becomes the least possible. The engine does a greater amount of work, and is subject to less loss. Thus the work to be done being fixed, it is done by a smaller, and, other things being equal, a less costly engine, and at the same by a more economical machine.

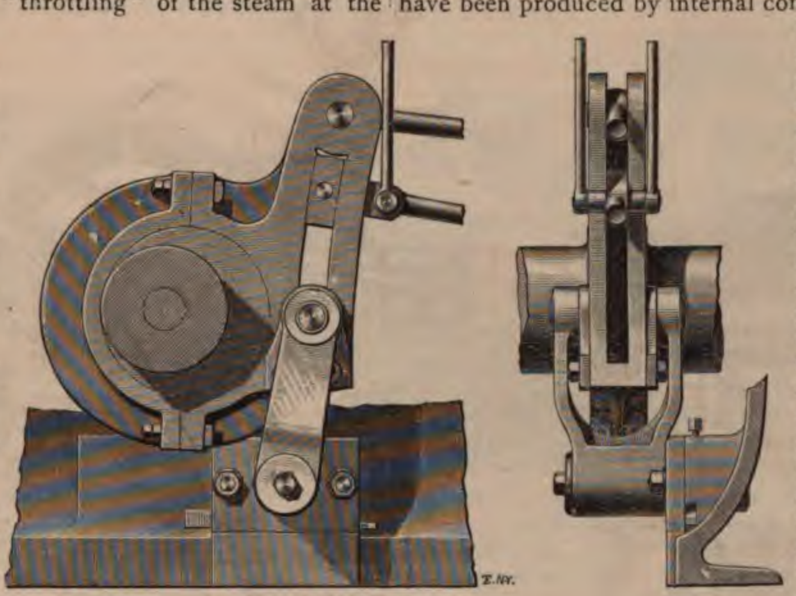


PAIR OF PORTER-ALLEN ENGINES.

Although this seems a sufficiently simple and axiomatic philosophy, and although the general tendency of practice in steam engineering had been plainly in this direction for many years, these points had not, up to a comparatively recent time been recognized by constructing engineers, and their progress had been slow and painful. The older firms who were engaged in the building of what were then called "expansion engines," were the first to detect this movement and its cause, and they led off, in a very conservative way, toward the construction of faster engines. The firms already mentioned as leading in the movement toward correct practice, came up to speeds far ahead of those common among other makers, and secured an advantage that was sufficient to prove unmistakably that they were in the right track. They did not, however, modify their designs in any great degree, with a view to adapting them to very high speeds. Their valve-gears were not of a kind well fitted to high speed of rotation; the builders, were themselves disinclined to accept the risks undeniably attendant upon rapid change in this direction, and the public to whom they looked for a market, were not educated up to such a point as would make it safe to attempt to go on very rapidly. A rather slow engine, with its comparative immunity from risk of serious accident in case any little derangement should occur, and with its greater durability under the ordinary conditions of use, was, by the great majority of designers, builders, and steam users, thought a far better investment than a fast engine, however well adapted to the radical illustration of a very interesting, but apparently impracticable, philosophy.

The first man to take up this matter with a will, and with a faith and a determination that were equal to the task, was Mr. Charles T. Porter, a young lawyer turned engineer, and Mr. John F. Allen, when the writer first knew him, a skillful mechanic, who was showing the natural bent of a real inventor, in the production of new devices, while engaged in the management of some of the best engines of 20 years ago The valve-gear of the Porter-Allen engine, is the invention of Mr. Allen, and its governor and general arrangement are due to Mr. Porter. It was Mr. Porter, also, who, by his courage, persistence, skill in business, and general good sense and management, finally, after years of struggle to secure good construction and workmanship, brought the engine into use in spite of every discouragement, whether due to circumstances, to direct opposition of competitors, or to public sentiment in favor of conservatism.

There are some interesting problems which present themselves to the engineer who attempts to design an engine to be operated at very high speed, problems which are by no means easy of solution, except to the boldest of innovators. One of these points of difficulty has already been considered. When the speed of revolution is increased, it is evident that a limit must sooner or later be attained at which the drop cut-off must be exchanged for some "positive motion" gear. But the various forms of such gearing familiar to engineers when Messrs. Porter and Allen became acquainted with each other, years ago, the still common three-ported valve, such as is used on locomotives, the Meyer valve with its cut-off valve on the back of the main valve, and kindred devices, were not adapted to the conditions sought by the engineer looking for a good system of expansion. They were simple and inexpensive, and could be used at any practicable speed of engine; but they did not always give a satisfactory distribution of steam. They usually produced a retarded steam supply, a "throttling" of the steam at the point of cut-off, which was not at all such as would satisfy the engineer familiar with the prompt action, and the "sharp corners" of the indicator diagram from the class of engine then taking the market. The dependence of the several parts of the motion upon each other was another objection to these devices, and the load which they threw upon the governor was a fatal defect, as the governor was then arranged and connected. Mr. Allen's invention placed in the hands of Mr. Porter just the device that he needed to carry out his idea of a fast engine.



The Allen Link.

This arrangement consists of a single eccentric driving a link motion to operate the steam valve, and to work the exhaust at the same time. The link is controlled by a Porter governor, and is so connected and driven, that the gear may be readily and quickly adjusted by the governor to any desired point of cut-off.

The eccentric and link are shown in the above illustration. The eccentric is set on the shaft in such a position, that its motion is co-incident with that of the crank. The link is a slotted curved arm, forming one piece with the eccentric strap, pivoted at the middle on trunnions sustained by an arm rocking about a pin set in the bed of the engine. The upper end of the link carries a pin, from which a rod leads off to the exhaust, which is driven without variable connections. The link-block is fitted to work in the slot of the link, from the end nearest the exhaust rod pin, down to the point opposite the pivotal point at which the trunnions are set. When it is at the upper end, the throw of the valve is a maximum; when at the lower point, it is a minimum. As the link-block is moved up and down in the slot, the motion of the valve is varied, and the ratio of expansion correspondingly altered. By an ingenious adjustment of a still more ingenious form of valve-motion, it is thus possible to obtain a valve movement of perfect precision at all speeds, and on both the forward and the backward stroke, with a quicker closing action, as the cut-off is later. The steam is allowed to enter the cylinder, at nearly boiler pressure, almost up to the point of cut-off, and the expansion line is a smooth curve very nearly from the junction with the steam line.

This form of indicator diagram has been usually considered peculiar to the class of engine described in the preceding articles. In this case, the diagram is nearly as sharp in the corners as those from a drop cut-off engine. The range of expansion is from the beginning of the stroke to about five-eighths.

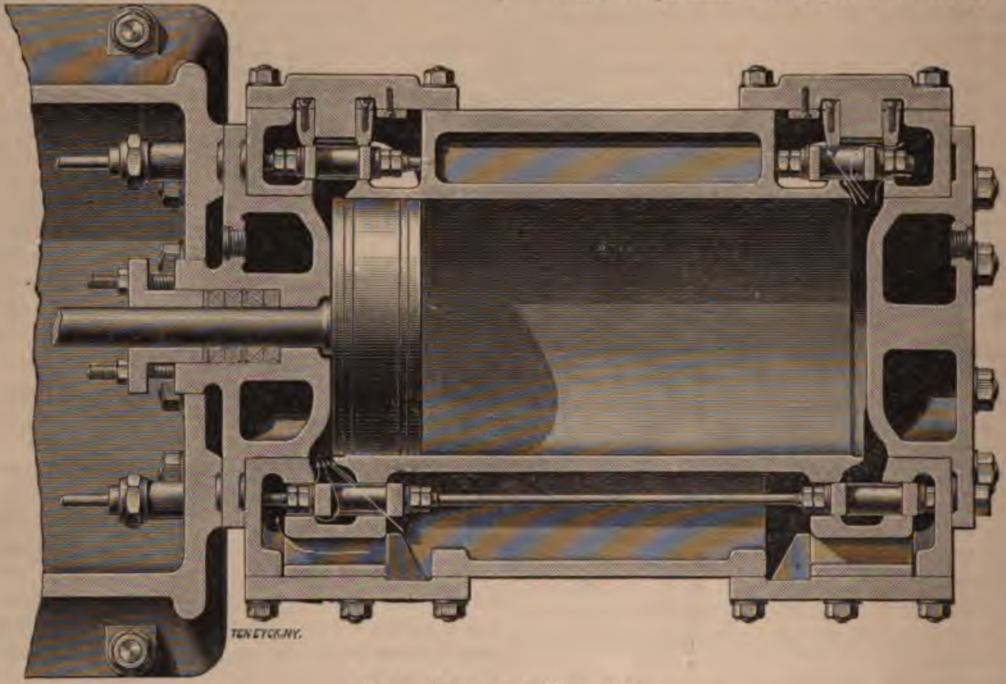
There are four valves, as shown in the next Fig., which is a section through the steam cylinder showing valve, ports, and general construction. The two valves at the upper side of the cylinder are the steam valves; the lower are the exhaust valves. The section is, however, horizontal, the valves being set on their edges at either side of the cylinder. The exhaust valves are so placed as to drain the cylinder of any water that may have entered with the steam, or may have been produced by internal condensation. Both sets of valves are so made, and set, as to be well balanced, and so as to be capable of having the wear taken up when it occurs. The steam valves are provided with packing plates, which are adjustable by hand, to make them steam tight, as well as to secure a perfect balance. Each valve is placed in a separate valve-chest, and can be independently adjusted. Each valve opens four ports; each is so set, that it is actuated by a rod in the line of its own centre; and all are but little liable to either wear or leakage.

The rock-shaft arm on the intermediate rock-shaft, seen in the large Fig. between the eccentric and the steam valve stem, assists in securing the quick opening and closing motion essential to a satisfactory distribution of the steam.

The features which have now been described, are not necessarily distinctive of a "high speed engine." A positive motion valve-gear, and a good steam distribution, are desirable in such engines, and the first point is, in fast running machines, an essential requisite; but the Allen engine, so far as it has been described, may be as well considered a slow as a fast engine. There are some details, to which we are now to turn our attention, which are essentially and peculiarly characteristic of the class to which this machine is assigned. Among these points are the strength and rigidity of parts which distinguish such engines; the great nicety of fitting; the excellence of all material in every part exposed to the straining action of inertia, and the minor but yet important modifications of details to adapt them to service in a machine, in which the slightest play in joints or bearings will be certain to make trouble. The bed is of peculiar design and is enormously stiff and solid, especially in those parts which take the stresses of the reciprocating pieces. It is broad and deep, with the line of thrust of piston rod carried close to its surface between the guides, and with a box form which gives great resistance to forces tending to twist it.

The steam cylinder is secured to the bed by the end, a construction adopted by Corliss many years ago, and one which gives all desirable strength, with freedom from those strains which come of connection of two large masses at different and constantly varying temperatures. The whole of its exposed surface is covered with lagging to prevent loss of heat by radiation. The main journal boxes are made in four pieces, and are set up by adjustable wedges, so set as to avoid the springing of the shaft that is sometimes found to occur with a less effective arrangement. The main-shaft journals, and the journals of the crank-pins, are made with especial care, skillfully ground to size and form, and nicely finished before the engine is assembled. The pin is always of "mild" steel, carefully case-hardened to give it a surface that will wear well and will not "cut."

The provisions for lubrication in such engines are not the least important of its details. The engine presents some neat devices in this respect which we have not space to describe.



STEAM CYLINDER (SECTION).

One of the most remarkable and interesting of the features, which especially adapt this engine to great speed of rotation, and one, the developement of which, in its theory, as well as in practice, is due to Mr. Porter, is a peculiar adjustment of weight of moving parts to the equalization of stresses on the line of journals between the piston and the crank-shaft. When the steam is allowed to follow the piston only to some point early in the stroke, the ratio of expansion being made, as is usual, between three and five, the rapid fall of pressure, during expansion and up to the end of the stroke, causes a very great variation in the effort exerted upon the crank-pin and other journals. As the maximum pressure occurs when the crank is passing the centres, and while the work done usefully is, in consequence of the slight travel of the piston, very little, and as, at the same time, the considerable movement of the pin under this pressure causes a considerable loss of work by friction, and as it is advisable to secure a uniform effort producing rotation, it is evident that it is desirable to find a method, if possible, of equalizing the pressure throughout the stroke without sacrificing the advantages of expanding the steam. The action of inertia in the moving parts is made by Mr. Porter, the means of securing this result.

At the beginning of the stroke, the inertia of the piston, its rod, the crosshead, and to a certain extent the connecting rod, all reciprocating parts, causes them to offer a certain resistance to the accelerated motion which they are compelled to take up. This resistance becomes less and less up to about half stroke, the point at which their velocity is a maximum. Passing this point, they are rapidly retarded, and this same property of inertia causes them to offer a resistance to retardation, which resistance now is felt as an impelling force at the crank-pin. Thus, the effect of the presence of these heavy masses in the line of connection, produces a reduction of pressure upon the pin at the commencement, and an increase of pressure at the end of stroke. But, in consequence of the varying action of the steam producing an excess of pressure at the beginning, and a deficiency of pressure at the end of stroke, we may combine these two effects, and the result is a comparatively uniform load upon the crank-pin throughout the stroke.

This compensation is capable of being, in many cases, very nicely adjusted by properly proportioning the weight of the reciprocating parts. As engines are usually proportioned with a view to strength of parts simply, the piston, crossheads, and rods are too light to be of much service in this way. Mr. Porter adopted the plan of making his piston and crosshead of such weight that the equalization of pressures should be the most complete possible, and this involved making them decidedly heavier than they are made in common practice, even when his engines were driven up to a speed which had never been before attempted in stationary engine practice. It is evident, however, that at some higher speed, the weights of these parts, as proportioned for strength, simply, would be sufficient to give this desirable adjustment of the load on the crank-pin. There is no reason to suppose that this, which would seem to be a natural speed of the steam engine, may not be at some future time attained.

An interesting fact in this connection, is that Mr. Porter, although not professionally a mathematician, or educated as an engineer, first worked out the relations of these forces by a simple process, and applied his results to his practice, and that, subsequently, at his request, a distinguished mathematician, Dr. Barnard, President of Columbia College, attacked the problem by the methods of the higher analysis, and revealed the laws involved, and verified completely the work of the engineer.

The large engraving on page 276, represents one of three pairs of engines in use at the Willimantic Linen Company's mill. They are 11½ inches in diameter of cylinder, and 16 inches stroke of piston; they make 350 revolutions per minute. This is not considered a high speed for these engines, however. A considerable number of these engines have been used in the electric lighting service of large cities, to which service they were the first to be adopted for driving large dynamos directly connected. Under some conditions, it is found that the weighted governor is too sensitive, or too much affected by inertia, to give perfect regulation. For such cases, Mr. Porter has designed an isochronal governor, which is free from this cause of variation.

Engines of this class have many advantages, consequent upon their high speed; they are, other things being equal, more economical in the use of steam; they can be given a very much smaller fly-wheel; they have, in consequence of the enormously reduced weight of wheel, less friction; they are more easily held to their speed by the governor; they are less subject to variation of speed between beginning and end of any one stroke; and they are usually less troublesome and expensive to connect to the load than slow running engines. These advantages are common to all classes of engines, as they are driven up to high speeds; the class here considered is simply better fitted to realize these advantages than the older forms of engines, because they are especially designed for high speed. The objection to the "high speed engine," is the increased risk of wear, and of accident due to their rapid motion, and especially the risk, that when accidents do occur, as they will now and then in the best regulated establishments, they may be vastly more serious than with engines working at ordinary speeds. The object of the precautions which are taken by builders of fast engines, are all directed to meeting this contingency, and to making their machines safe against accident. These precautions are seen to be the strengthening, and especially the stiffening, of all the parts exposed to the stresses due to the action of inertia in the reciprocating pieces; the adjustment of all parts to each other in such a manner as to avoid spring; the use of the best material; an affective system of lubrication; and the securing of the most perfect workmanship.

Watt once congratulated himself that he was able to get a steam cylinder that only lacked three-eighths of an inch of being truly cylindrical; the builder of the "high speed engine" of to-day works to the thousandth of an inch, in longitudinal measurements, and gets his cylindrical journals exact to the twenty thousandth, perhaps to the forty thousandth of an inch, a quantity which can be detected by a good workman. The contrast illustrates well the progress of a century in accuracy of workmanship where nicety is required. Such nicety, only, can make a fast running engine safe; such accuracy *does* make it safe, and such engines now do their work uninterruptedly, year in and year out, and are found to require no more than that ordinary care which all engines are expected to receive.

A Porter-Allen engine, from the "Southwark Foundry," supplied power to the Weston, Edison, and the Thomson-Houston Electric Light Companies, at the Railway Exhibition, at Chicago, May and June, 1883.

—— *Boston Advertiser* says: The English sparrow must go. At Frederick, Md., on Saturday night, a flash of lightning killed 200 of these sparrows that were roosting in a tree.

OUR PARIS CORRESPONDENCE.

PARIS, August 1st, 1883.

AMONG the applications of electric accumulators, their use as a traction power on tramways and railways has received especial attention in England The different services that they can render have been explained by Dr. Siemens and Mr. Ayrton in various lectures, and the public has naturally placed a certain amount of confidence in the word of these *savants*. Public experiments were made in England some three months ago, but without any very notable results. Nobody doubts, at present, the possibility of drawing vehicles with the accumulators, but the question is, to know what weight must be used, and the cost of the electric horse-power per hour.

The company that is working the Faure Sellon-Volckmar patents, under the management of M. Phillipart, has thought proper to make new experiments in France, and a car was run at night on the Paris tramway lines, to show the advantages of it for the omnibus company. It is a very seductive offer to replace thousands of horses by accumulators, and in the prevailing ignorance on the question, it is easy to make up calculations in favor of electric traction. This is what M. Phillipart has done in a letter to one of the directors of the omnibus company, and as we do not share his illusions, we shall point out the weak and doubtful points of his arguments We will say at once, that we shall discuss the accumulators as they are, and not as they may be, for we do not despair of seeing them being further improved.

M. Phillipart sets out from the fact at the experiment, that an electric horse-power was employed during one hour per ton of the drawn weight, to make a trip of 11 kilometres, with a machine giving 70 per cent. of useful work; he admits that there is a loss of 25 per cent. of electricity, both, in charging and discharging, and we think this figure reasonable. A ton of accumulators, according to him, could give out 30 electric horse hours, which we believe a little exaggerated. If the weight of the boxes and liquid is considered, not much more than 20 horse-power per ton will be obtained. The dynamo machine, which works the car wheels, is put down at 2,500 francs for a power of from 12 to 15 horses; the maintenance and wear are insignificant, as we know; the important point is the price and maintenance of the accumulators.

Here we differ in opinion; to give 600 francs per ton as the cost of accumulator plates of suitable sizes for electric traction, and to estimate the discarded positive plates at 250 francs per ton, is an indulgence in both exaggeration and its opposite. Copper is now 340 francs per ton in this market, and we think the manufactured plates cannot come to 600 francs. Before putting a value on the used plates, it would be necessary to know their condition. Neither must it be forgotton that the boxes are relatively dear, and wear out very rapidly. Admitting a renewal of the positive plates every four months, M. Phillipart concludes that the net cost of maintenance would be 525 francs per ton, and with labor, 600 francs.

He does not speak of the patent royalties, nor the wear of the boxes, and thinks that the renewal of the plates could be made, weight for weight, which is very doubtful.

The company that has these accumulators in hand, is selling them at present, at the minimum rate of 3 francs per kilo—the divergence, as is seen, is sufficient to inspire us with some mistrust of the price of 600 francs per ton.

The tramway car would be drawn by an electric traction engine, 2 metres (78 inches) in width, by 4 metres (156 inches) in length, with a total weight of 8 tons, of which 3 tons are for accumulators. In this way a power of 90 horse-power per hour, would be available for a total weight of 15 tons (traction engine, car, with 50 passengers) during five hours, with a reserve of 15 horse-hour. Each traction engine would cost $2,000, and two would be allowed for each car, thus we should have an outlay of $4,000. The tramway cars make eight complete trips a day, and a team of two horses only makes two trips, so that, at present, eight horses are employed to each car; not taking into account that they rest one day every five. I do not believe that horses and harness cost $4,000, as M. Phillipart says, but, at the outside, some $2,400; there would be, therefore, considerably greater outlay, at first, for the accumulator's plant.

The estimates for working expenses, seem to us to be somewhat open to question; the steam horse-power hour costs 10 centimes, in Paris, and not 5 centimes, so that the electric charging of the engine would come to 20 francs, instead of to 10 francs. The cost of oiling and keeping up the dynamo machines, and the traction engines, would be upwards of 5 francs per day, per apparatus. As to the figure of 20 francs per day of running —representing the interest and sinking fund of capital, the maintenance of the accumulators, and general expenses—we do not think it at all proved. M. Phillipart thus arrives at fixing the expenses of the car, per day at 35 francs, but he takes care not to inform us of the present cost of the eight horses that he wants to replace. He prefers to play with figures; thinks that the supplementary passengers in the traction engine would bring in 50 francs per day, and ends with the statement (which, coming from him, is not surprising), "*I may even be mistaken as to fifteen francs, and yet draw your car for nothing.*"

Such methods of discussion are not calculated to inspire confidence among serious people. It may be observed that the establishment of electric traction would cost 250,000 francs per line (?). It would be requisite to know something more about accumulators before embarking in such an enterprise. All we know of them at present, is of results obtained in the laboratory. After the failures, in Paris, of steam locomotives, and of compressed air and hot water engines, it is rather rash to speak about the infallibility of electric traction. We will not dwell any longer on this subject, and let the reader form his own appreciation of the project from the figures given by M. Phillipart.

There is a tendency to increased use of wires of silicon bronze in telegraphic and telephonic lines, especially in France, Italy and England. It is of some interest, therefore, to point out the essential principles of the patent of M. Lazare Weiller, which has been taken out under the title of "Modification in Methods of Manufacturing Copper or Bronze containing Silicium." Matters, that by their mutual re-agents determine the production of metallic sodium, are put in the metal while in a state of fusion. The metallic sodium, in turn, reduces the combinations of the silicium, which then combines with the copper.

The inventor recommends the following proportions: fluosilicate of potash, 450 grams; glass in powder, 600 grams; chloride of sodium, 250 grams; carbonate of soda, 75 grams; carbonate of lime, 60 grams; and fused chloride of calcium, 500 grams. The mixture of these substances is heated in a plumbago retort, to a temperature a little below the point when they begin to react on one another, and it is then placed in a copper or bronze bath, when the combination of the silicium takes place, as already said.

M. Weiller's first idea was to use phosphor-bronze for light electric conductors, but he saw that that metal, even when it admitted of being wire drawn, was still very brittle and bad tempered, under changes in temperature. This defect was especially noticeable in Italy, where phosphor-bronze wires had to be given up. Very remarkable results have been obtained from the new bronze, and on the same Italian lines, perfect satisfaction has been expressed with its introduction. Without wishing to make too much of theoretical considerations, it seems natural to suppose that silicon, like phosphorus, acts on oxide or sub-oxide molecules, which it is difficult to free copper from, and that it substitutes silicide of copper for these impurities, or brings back the metal to a pure state. The superiority of silicon is explained by its better adaptability to being worked at a high temperature, by its penetrating the metal better, and, consequently, insuring the indispensible homogenity. It may be said of silicon bronze, that it possesses the conducting qualities of the best copper, with the resisting qualities of the best iron, along with this precious peculiarity, that each of these advantages may be varied at will, at the expense of the other.

Applied to aerial lines of telegraph, the present galvanized wires of the great lines, 5 millimetres in diameter, and weighing 155 kilos, per kilometre, can be replaced by silicon bronze wires of 2 millimetres in diameter, weighing only 26 kilos to the kilometre; while the ordinary steel telephonic wires of 2 millimetres diameter, and 25 kilos to the kilometre, may be replaced by silicon wires of only $1\frac{1}{10}$ millimetre in diameter, and weighing 8 kilos to the kilometre. Thus the weight of the wires may be reduced to a third or a sixth, thereby greatly facilitating the putting up of the wire, lessening the load on the posts and frames and lengthening the distances between them. The $1\frac{1}{10}$ millimetre wire gives no hold for wind or ice. Distances of 300 yards, with 12 wires, have been tried at Rheims, and it was found that the noise from vibrations was less than from steel, thus doing away with the use of sourdines. From the reports of the use of this metal, especially from Italy, where it has been made on a large scale, we are led to believe that it is admirably adapted for aerial telephonic lines. It is true it has only been in use for a year, but no fault has yet been found with it, and a great many persons in a position to form an opinion, among others, the director of the Italian Telephone Co., praise it unreservedly.

I have already spoken of the plan to form an electrical society in Paris, and of the difficulty to understand its utility. The statutes of the company which I have now before me, show that it aims principally at being an aid society. The committee, among other occupations (Art. 8), deliberates and acts on requests for pecuniary aid that may be addressed to it; the names of the assisted persons to be kept secret; it is also to keep posted as to all vacant positions and places that may be created, that electricians at home or abroad could fulfill. It requires a considerable modicum of *naïveté* to believe that such a society could render the slightest service in France, where from the highest to the lowest, we push the spirit of independence to the utmost. Besides, Art. 14, which is as follows· "A regulation will be drawn up by the management of the society, which will be submitted for the approbation of the Minister of the Post Office and Telegraphs," denotes an intention on the part of the founders to have governmental influence predominate in the society. Under these conditions, we can hardly see the benefit that independent electricians could derive from such an institution; it would be sufficient to create a special bureau in the telegraph department, without at all asking for the subscriptions and adherence of electricians.

At the time of the International Congress of Electricians, in Paris, in 1881, the question was asked whether aerial lines constituted a danger or a defense, in case of storm, for the buildings below them. M. Lartigues, who is at present director of the Paris Sociéte Génerale des Téléphones, expressed the opinion that the houses on which the posts and bearers of the aerial lines are placed, were no more exposed than other houses to being struck by lightning. M. Helmholtz, without being so positive in this view, recommended that lightning rods should be placed at the extremities of the lines, and to put the iron posts and bearers in connection with the metallic parts of the houses, and with the earth, so as to form a kind of lightning rod. Since that time meteorological observations have not shown, as far as we know, that aerial telephonic lines are especially attacked by lightning, on the other hand, the accidents on telegraphic lines have been very few. Still, there are many people who are afraid of using the telephone during a storm. With the design of reassuring these persons, M. Béde made some experiments at Brussels, during the great storm of June 30th last, which we believe it useful to give a short account of. Placing the telephone at his ear, he heard a continuous noise, like that of a carriage; louder sounds were heard, however, at every moment, which he likens to the bursting of oil bubbles at one time, and again to a drop of oil falling on a red hot metal plate. This phenomenon came suddenly and well defined at each flash of lightning, and seemed to precede it, as far as can be judged when the impressions of hearing and sight have to be relied on. These same "crackings" have been observed when there was no lightning, but then they were weaker.

During the storm some 600 falls of the electric alarms were observed in the Brussels central office, especially in the direction where the lightning fell. Still, not a single telephonic apparatus was put out of order, not a single one of the 600 lines were made unserviceable, and not a house or a post was struck. There were only some sparks at the lightning conductors, and the alarms in the central office.

It would be interesting, as a study of atmospherical electricity, to compare these effects with those produced in the telephone by the aurora borealis.

Observations made last year, by M. de Lalagade, have shown that in the latter case, somewhat similar sounds to those pointed out by M. Béde were heard. The practical conclusion to be drawn from these observations, is, that there is no danger whatever in using the telephone, even during the greatest storms, but doubtless further trial must be had before this view will be unreservedly accepted.

M. Divers has been led by an examination of the reactions occurring in the Leclanché battery to propound a new theory of them. When the hydrochlorate of ammonia is made to act at the same time on the zinc and binoxide of manganese, hydrogen and ammonia are liberated, and the solution is charged with zinc and manganese ; the liquid deposits a brown substance on contact with the air. It is also ascertained that the binoxide is coated with a compound of zinc and manganese, that is soluble in the hydrochlorate of ammonia. In the battery, we have, first, the primary action, just spoken of ; then, a secondary action, which polarizes the battery and gives rise to a compound of zinc and the binoxide of manganese. The depolarization is next due to the action of the hydrochlorate on this compound. There is a liberation of ammonia, and formation of binoxide, and of chloride of manganese at the same time, as a combination of zinc and hydrochlorate of ammonia. We do not believe it necessary to pursue the subject further, which is of interest to *savants* only.

In concluding, I believe, it is worth while to mention an experiment that has been lately made in the workshops of the Paris Compagnie Électrique, with a machine, which has some novelties, introduced by M. Gramme, an effective power of 31 horse was electrically transmitted, the power was measured on the breaks, the generating machine took 48 horse, which gives a practical product of over 64 per cent. I confine myself to mentioning the fact, as I trust to send you exact details shortly. The electro-motive power was about 900 volts, and the intensity 30 ampères.

PH. DELAHAYE.

FROM OUR SPECIAL CORRESPONDENT.

VIENNA, August 5th, 1883.

To the Editor of the Electrician :

DEAR SIR :—A short walk from the city through the promenades and drives of the park, leads to the " Rotunde," the fine looking permanent building in which the coming International Electrical Exhibition is to be held. The exhibitors being very much behindhand with their exhibits, the opening had to be postponed until August 16th ; there are, therefore, at present, very few exhibits in place. The general arrangement of the exhibition, however, presents some points of interest.

The centre of the building is covered with a huge dome, the inside of which is to be illuminated with a large number of arc lights, arranged in circles, one above the other, the whole having the appearance of a huge electrical chandelier. Directly under the dome, and surrounded by trees and shrubs, is a fountain arranged in several circular cascades, to be illuminated with electric lights, from the inside and outside. In one end of the galleries, surrounding the dome, is a library and reading room containing works on electrical subjects only. Next to the library are several series of telephone rooms, in which are a large number of telephones connected with the opera house, theatres, and several concert halls in the city. In the other end of the galleries is built a small theatre, which is to be lighted entirely with the incandescent light, to show its advantages in producing certain stage effects. Among other attractions, is a series of illustrated lectures on subjects pertaining to electrical science, to be given in this hall several times a week, by distinguished electricians, among whom are Sir Wm. Thompson, and Sir Wm. Siemens.

In one of the galleries is a series of rooms, decorated in various styles, representing the different rooms of a house, to show the application of incandescent lights for interior illumination of dwellings In the courts, between the dome and the galleries, are the boiler house, a building for illustrating the transmission of power by electricity, a small theatre, and the accumulators.

An electric railway connects the exhibition building with the horse car lines and elevated railroad. The rails are used as conductors of the current, and to avoid accident to horses and carriages at the street crossing, the rails at that point are insulated from the others, the current being conveyed by conductors under the rails, the momentum of the cars carrying them over the crossing Another interesting feature of the exhibition, showing the application of electricity as a power, is the transportation of the coal from the railroad depot to the boiler house over a portion of the building, by wire rope carriers driven by electric motors.

CARL HERING.

THE SOUTHERN EXPOSITION AT LOUISVILLE.

LOUISVILLE, Ky., Aug. 22, 1883.

To the Editors of The Electrician :

Possibly the most attractive feature of the great Southern Exposition at Louisville, Ky., is that of electric illumination and of electric transmission of power. The Edison Electric Light Company, of New York, are under contract with the Exposition Company to light the main building, a structure with an enclosure of about 500,000 square feet. This company is to furnish 4,600 incandescent lamps of sixteen candle power each, for which it receives five cents a night for each lamp, or $23,000 for 100 nights. In order to do this, they have installed a plant, embracing fifteen dynamos, capable of furnishing 300 lights each. To drive these machines are a Corliss engine of 500 horse-power, three Armington-Simms engines, same as used by the Edison company in its famous New York plant.

The Edison company claims that it is not an exhibitor, being under contract to illuminate the building, and, therefore, it has made no attempt at elaboration of fixtures and surroundings. It would not be fair to criticise the success of the lighting of this vast space at present, as the full complement of lights have not yet been placed The value of this plant, including cost of construction, is said to exceed $75,000. The incandescent light in the art gallery, which is an annex situated some 300 feet from the main building, attracts attention.

At the present time there is but one electric light company as an exhibitor. The United States Electric Lighting Company, of New York, is making an extensive display of its machinery for the production of both arc and incandescent light, and the electrical transmission of power. By the terms of the contract between the Exposition Company and the Edison company, no arc light is permitted within the main building, and, therefore, the United States company's exhibit of arc light is confined to one of the annexes, and to general illumination about the main building. This company exhibits one arc machine with a capacity of 50 lamps, or 100,000 candle power.

Another electric light company, the Jenney, of Fort Wayne, Ind., has a contract with the Exposition Company for lighting the immediate exterior of the main building, and Central Park, which is adjacent. This company has been doing business but a short time. It receives 35 cents per lamp per night for 75 lamps, which number is furnished by five dynamos, with a nominal capacity of twenty lamps each.

In the matter of electrical transmission of power, the Electric Transportation Company is making a grand success, having constructed a railway around the park nearly one mile in length. This is the same exhibit, however, that was made at the Chicago Railway Appliance Exposition, of which some account has been given. There is this difference, however, between its exhibit at Chicago and the one made here: the former was an elevated railroad, so to speak, while this is a veritable railway on the ground, its track being of the same construction as that of an ordinary narrow-gauge railway. In addition to its engine, it draws two coaches with a capacity of fifty adults. For the propulsion of this railway train, a Weston motor of 16 horse-power is used with perfect success and great economy, since, at no time, is there a demand for more than five or six horse-power to drive the train at the rate of twenty miles an hour. The gearing, however, is constructed to give a speed of twelve miles per hour. This railway is certainly a complete success, and serves to show the great possibilities of the early future. Hundreds of persons are daily carried around this beautiful park at lightning speed with an unseen hand, and apparently without the aid of any power whatever.

The American Electric Light Company is preparing to make an exhibit of its system of illumination.

The Southern Exposition, when all these electric light companies have their machinery complete for performing their respective parts, might well be called an electrical exposition. Yet all its departments are so complete and of such magnitude as to make this exposition far superior to anything of the kind ever produced in this country, excepting only the Centennial of '76.

F. L.

THE UTILIZATION OF THE WIND FOR PRODUCING ELECTRICITY FOR THE SUPPLY OF CITIES, TOWNS, AND VILLAGES.

A CORRESPONDENT of the London *Electrical Review* gives the following suggestions on the above subject:

To employ the power of the wind and the tide for the production of electric energy, has often been spoken of, and is now occasionally talked about. There may be better plans than those I am about to submit to you. I have never seen but one plan for utilizing the power of the sea. It is the irregular force of both wind and tide that has to be overcome to make either practicable for the purpose of driving dynamos or magneto electric light machines.

There is, at the present time, a number of windmills to be seen in different parts of the country, especially in Kent, for the purposes of turning millstones and pumping water.

At first sight it seems that nothing could be more easily and cheaply erected than such a contrivance for the purposes of electric generation, and this would be so if the wind always blew with the same force; but as it does not, this falling off in wind pressure forms one of the greatest obstacles in using the power of the wind for the driving of generators of electric energy.

That there is a very large amount of power generated when there is a moderate breeze blowing, is proved by seeing three or four pairs of millstones driven at the same time in a single mill.

There is a mill situated between Ramsgate and Pegwell Bay that drives four pairs of millstones, and yields, I believe, about twenty-four horse-power. There is also another mill of a similar kind, situated near the estate of Sir Moses Montifiore, on the East Cliff, Ramsgate, of about twenty horse-power.

Those mills, and the cliffs with the sea beneath, suggested to me several years ago how easily and readily power might be obtained with great constancy for the driving of electric generators. I will, therefore, lay before your readers the plans that suggested themselves, and the way in which they could be carried out to a practicable and, I believe, a profitable issue, at or in any place where the land stands high, or near the sea, or in close proximity to a water stream. Plan 1: It would be necessary, in the first place, to construct a reservoir at the bottom of a cliff, to be filled with water when the tide was high. At the top of the cliff could be dug another reservoir. This upper reservoir would be filled with water pumped up from the lower reservoir by means of wind engines, and by either centrifugal or reciprocating pumps, Thus the water would be lifted little or much, just as the wind blew, to be allowed to fall again through pipes and drive suitable turbines, and those turbines again driving the electric generators. It would be also advisable to have a suitable steam engine for occasional pumping when the wind did not blow. By the above means a constant source of power would be supplied. At times, when the wind blew more than usual, there would be much more water pumped up, and, therefore, the upper reservoir should be much larger than the lower one, as the lower reservoir could be filled every high tide, if found necessary. Thus the electric energy could be used either direct from the machine, or stored in accumulators, or the two used together during night. If a small stream of water was near, it could be employed to fill the upper reservoir, or to assist in keeping it filled. The water, as it fell from the upper to the lower reservoir, would be constantly pumped up again, and thus the irregular force of the wind might be utilized in bringing about a very constant available force, which is so necessary either for the utilizing of electricity direct or for the charging of storage batteries.

Plan 2: In isolated places, or otherwise, where a reservoir could not be constructed, wind power might be utilized thus: Erect a wind engine or two, and by this means raise a weight (say a large iron case, filled with either sand, or stones, or earth), or it might be so made that it could have iron weights packed in. This weight might be increased to many tons, depending upon the horse-power required out of its descent. This weight must be so arranged that it can be lifted through a given height, and when driving power is required, by allowing it to descend; its falling power could be given out by means of a chain, or rope, suitably attached, so as to drive a dynamo machine and be used direct, or for the charging of storage batteries. By this means, it appears to me to be practicable to utilize an irregular natural force and bring about a constant force.

I feel that many will say that this is a very primitive way of going to work; nevertheless, it is a means of utilizing those natural forces so often talked of for the production of electricity.

A. J[illegible]JARMAN.

ELECTRICITY FOR A HORSE.

"ABOUT three weeks ago you had an item in your paper telling about a new scheme for curing balky horses. It was an electric battery to be placed in the buggy, with wires running to the horse's bit, and when the horse balked, the instructions were to touch a button with the foot, when the electric current would go to the horse's mouth, take his attention from his balkiness, and he would get along all right. Do you remember such an item?"

The editor scratched the bald spot on his head, looked wise, and said he did remember something about it, and asked the visitor if he had purchased a battery and tried it.

"Tried it!" said he, as he picked up one of the crutches and fixed the splints on his sprained arm. "Yes, sir, I tried it, and it is a wonder that I am spared to come in and maul you. I live out near Eagle, and have got an old mare that has been balky off and on for sixteen years. I read about that battery, and sent to Chicago and got one, and rigged it up in the bottom of a wagon, and fixed the wire in the bit just as you said. One morning, about a week ago, I hitched up the old mare to take a few cans of milk to the cheese factory, and I was afraid that she wouldn't balk so I could cure her. Well, I got almost to the cheese factory, and the old mare balked. I touched the button with my foot, and I could see that the old mare got the shock, because she stuck up her ears and shook her head. Just as I stepped on the button again, to give her the second dose, she switched her tail around and caught the wire, which was quite slack, and wound it around her tail about four times, and my foot was on the button. Oh, how she kicked. I forgot to take my foot off the button, in the excitement, and kept the electric current going. and the air was full of heels and pieces of wagon, and milk cans, and me. She seemed to have the strength of a hundred horses, and it seemed to me as if the whole conveyance, horse and all, went over the trees as though carried by a cyclone. I and the wagon came down first, and then it began to hail milk cans and rain milk, and the old mare stood there with the copper wire wound around her tail, kicking and pawing milk cans and tipping pieces of wagon on me. The boss of the cheese factory got me by one leg and pulled me out of the wreck, and one of the neighbors got hold of the battery and pulled the wire off from around the mare's tail, and she went to eating grass, and drinking some of the milk that had collected in a hole in the road, and they got me home, and I have been in bed ever since till this morning. I came in on the train to see what you would give to settle. I don't want to be hard on any man that is struggling along to build up a business, but it does seem to me there ought to be a responsibility somewhere for such outrages."

The editor looked wise some more, and finally told the man that if he had not paid a royalty for the use of the electric balky horse persuader, he was liable to be arrested by a United States marshal and taken to New Jersey for trial on a charge of infringement on a patent, and that it would cost him thousands of dollars.—*Peck's Sun*.

—— *Post* says:– The London *Lancet* notes a very important new departure in medical science. Dr. De Watteville has been appointed physician, at St. Mary's Hospital, to the electro-therapeutic department. In other words, the most progressive and successful of the smaller London hospitals has, after a long struggle, elevated electricity as a medical agent into the sphere of accepted and acknowledged science. The experiments of Dr. de Watteville with electricity were for a long time derided by the medical faculty, but now he is accepted as one of the highest authorities in all nervous diseases. He has been ten years in accomplishing this result.

THE NOTHOMB LAMP.*

THIS incandescence lamp is distinguished from its predecessors by the nature of the incandescent filament and the mode of manufacture. This filament consists of cellulose carbonized in a carbureted atmosphere which impregnates it with carbon. It is one millimetre wide and $\frac{4}{10}$ths of a millimetre thick; its length depends on the luminous intensity required. The atmosphere of the globe of glass in which it is inclosed consists of azote, hydrogen, or any other inert gas.

The filament is fixed to conductors by means of a special kind of cement, composed of a mixture of spongy platinum and an organic substance, molasses or sugar, which on carbonizing forms carbon of very close texture and great consistency. The duration of the lamp, according to the experiments made, should be from 800 to 1,000 hours; the luminous power 30, 50, or 100 candles; there are thus four types, A, B, C, and D, which work with currents of from one to three ampéres, and electro-motive forces of from 45 to 100 volts, according to the luminous power.

By calculating the expenditure of energy corresponding to these constants and comparing it to the luminous power, we see that the Nothomb lamp, like all the incandescence lights, gives a light of from 250 to 300 candles per horse-power of electrical energy.

The type, D, of 300 candles, has three filaments, it requires 100 volts and nine ampéres, or 300 volts and three ampéres, according to whether the three filaments are coupled in series or parallel. While adopting the horse-shoe form of filament, the inventor acknowledges that the best results have been obtained from the spiral ones. The same effect has been noted with incandescent conductors formed of spirals of platinum wire, which require a smaller amount of electrical energy to bring them to a certain degree of incandescence when they are coiled into a spiral than when they are straight or merely loop-shaped. It is probable that the difficulties in manufacturing the spiral carbon filaments alone prevent their employment for industrial purposes, for they would effect a real economy of motive power, a most important point in electric lighting by incandescence.

—— EXECUTION BY MEANS OF ELECTRICITY.—An English contemporary reports, that Sir W. Harcourt was subjected to some considerable amount of questioning in the House of Commons, the other night, as to the recent unfortunate circumstances attending the execution of a man named James Burton at Durham last week, the facts of which were reported in the daily papers. Mr. Cowen asked the Home Secretary whether "some more scientific mode of killing criminals by electricity or poisoning could not be adopted," in place of the ordinary procedure as entrusted to the hands of Marwood at the present time. This matter has been the subject of some considerable discussion and thought at different times, and we believe that numerous devices for despatching criminals rapidly and painlessly have been invented, but up to the present they do not seem to have emerged from the laboratory stage. In all probability capital punishment will be abolished before electricity is summoned to the aid of the executioner.

—— WAUSCHAFF, of Berlin, has lately made a piece of apparatus for registering earth currents. It consists of a very delicate galvanometer inclosed in a case, with a clockwork arrangement for moving a photographic plate steadily downwards. A fine ray of light is reflected on to the galvanometer mirror by a total reflection prism, and is focused on the photographic plate. The speed of the movement of the plate is 80 mm. per hour, thus allowing variations from minute to minute to be observed.

SPARKS.

—— THE PATENT INTERFERENCE CASE of N. S. Keith, of the American Electric Storage Company of New York vs. Charles F. Brush, of the Brush Electric Company of Cleveland, O., has been decided in favor of Brush.

—— A CURIOUS DEFENSE AGAINST THUNDERBOLTS.—In the French villages in the Province of Quebec, upon the front door of the houses of the habitants is inscribed: "Arretez, le sacre cœur ote Jesu est avec moi," which the devout people consider an infallible defense against lightning.

—— PROF. HARRIS, of the Concord school of philosophy, says: "That which should be continued by its environment might be still finite if it would arrive at an environment of a different kind, which did not continue it." And right in the face of this statement the telegraph operators struck.

—— A TIPSY YOUNG GENT, hailing from San Diego, while staggering through the streets of Los Angeles one night recently, was considerably confused at the number of electric lights visible, and managed to blurt out: "How many blamed moons do they have in this country anyway?"—*Semi-Tropic.*

—— IN THE PATENT interference case of Weston against Sawyer and Man, of New York, involving priority of invention for improvement in the art of manufacturing carbon conductors for incandescent lamps, the Examiner of Interferences has rendered a decision awarding priority of invention to Weston.

—— THE BOARD OF EXAMINERS IN-CHIEF of the patent office has rendered a decision, reversing a former decision of the Examiner of Interferences, and awarding priority of invention to Thomas A. Edison for an "incandescent conductor for an electric lamp formed of carbonized paper." William E. Sawyer and Albin Man contested Edison's claim.

—— IN A LETTER to the *Tribune*, describing Krupp's great establishment at Essen, Mr. Robert Porter states: "The establishment has its own water and gas works, and besides the electric lights there are nearly 25,000 burners. The firm have their own chemical laboratory, photographic and lithographic establishment, printing shop and bindery. There are about 50 miles of telegraph and 35 telegraph stations belonging to the establishment."

—— THE BEST METHOD of treating clear glass globes, to cut off the glare from arc lights, is to paint them with a mixture of white zinc and turpentine; under no circumstances use either white lead or any oil. By varying the proportion of the zinc, the preparation will slightly obscure the globe, or make it dead white. Whiting and glue is frequently used for this purpose, but it is fit only for inside lamps, and cannot be put on as evenly as the zinc. This mixture is suggested for skylights and greenhouses.

—— "IS THE MAN MAD?" "No, the man is not mad." "Then what makes him yell so?" "He is talking to a man a mile away." "Through that little instrument?" "Yes, through that instrument of torture called a telephone." "Will he make the man a mile away hear?" "Certainly he will. But he could do it just as easily by yelling out of a window." "Why, does not the telephone work?" "No, it does not work; the man using the telephone works; jot that down in your mem."—*Hartford Post.*

—— *Nature* says:—The telegraph has made another step in advance in China. It has had the honor of being mentioned in a memorial to the throne. Li Hung Chang recently mentioned, in a report to the Emperor, that he received certain information by telegraph. And, more wonderful still, that mysterious and awe-inspiring document, an Imperial decree, written with the vermilion pencil, has actually been despatched by telegraph—for the Viceroy of Canton reports recently, in a memorial, that a decree had been conveyed to him in this way.

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* From London *Electrical Review*.

—— AN ELECTRICAL OMNIBUS was recently tried on the Cour de Carrousel, Paris, before M. Cochéry, to prove the facility with which this sort of carriage is handled, in spite of its immense weight. The trial, which took place in the busiest hours of the day, attracted much notice from the passers-by, and was generally deemed satisfactory.

—— M. MERMET has recommended, in the *Chronique Industrielle*, the use of nickel crucibles instead of silver, in chemical manipulations. They are slightly attacked, it is true, by melted potash, but silver itself is not indifferent to this action. They cost, at first, much less than silver, and, moreover, they have the great advantage of melting at a higher temperature. It often happens, in fact, that inexperienced chemists melt their silver crucibles in heating them over a gas lamp; such an action is not to be feared with nickel crucibles.

—— DURING A RECENT SHOWER the lightning struck a dwelling house in Norwich, Conn., not, however, doing serious damage to the building. In leaving the house the electric fluid leaped across an interval of a foot to an iron service pipe, which protruded through the basement wall, and to which a small hose is attached for sprinkling the lawn. Thence it passed along the pipe, through the house and under the ground, to the street, 75 feet distant, where it burst the main pipe in a half dozen or more places in a distance of 150 feet, cutting off the water supply of the entire neighborhood.

—— *Revue Scientifique* reports, that the Chevalier Frédéric Franchetti, engineer at Leghorn, has referred M. de Parville to a curious passage in Galileo's "Dialogues" touching a possible early origin of the electric telegraph. In the dialogue Sagrado says, that he calls to mind a man who wanted to tell him a secret which would give him the power, by means of a certain sympathy of magnetized wires, to speak to any one two or three thousand miles off. The bargain, however, fell through, as the inventor would not try any shorter distance, and Sagrado declined to go to Cairo or Muscovy to try the experiment.

—— AN ENGLISH PAPER states, that on one of the telegraphic systems in France, a modification of the Blake transmitter has been introduced. It consists in replacing the microphonic system of Blake by a system composed simply of a ring of cork, behind which is placed a grill of five carbons, of which two are fixed and three movable. By this method very satisfactory results have been obtained, these micro-telephones having worked for nearly a year without requiring once to be touched. M. E. de la Bedoyère advocates the employment of the cork membrane, which gives much greater clearness to sounds and speech than the deal disc. This assertion is supported by numerous experiments which have been made with membranes of various kinds.

—— AN ENGLISHMAN, traveling around this country, relates two of his experiences, which are of interest to many of our readers. In journeying from Boston to New York, he traveled from Fall River to New York on the steamer Pilgrim, which is illuminated by the Edison lights. After an enthusiastic description of the steamer, he said:—The air is good, and this is due, in part, to the fact that the use of the incandescent electric light in all parts of the ship leaves the atmosphere uncontaminated by those vapors and impurities which are thrown off from lights produced by combustion. And the incandescent light is so convenient! You enter your stateroom, turn a little key in the bracket on the wall, and—presto! the place is filled with a clear, white light. This is very different from the experience you have sometimes had when your last match failed you, and you had to wait for light until the servant responded to your summons. The effect of the electric-arc lights on Brooklyn bridge, while entering New York harbor, is thus described:—As we steamed toward the city the flash of a gun from Castle William, the heavy report and its echoes, and the slow descent of the national ensign from the tall staff on Governor's Island marked the hour of sunset. Suddenly the electric lights on the great suspension bridge, beyond the island, flashed into brightness in rapid succession, forming a brilliant arch across the river, and seemingly just above the island. I am tempted to call it a fairy spectacle, but the expression is trite.

—— AN EXPERIMENTAL TOWER, to be used for testing the availability of the electric light in light-houses, will be erected shortly at the light-house depot at Tompkinsville, S. I.

—— THE FOLLOWING is the tenor of the French ministerial decree, laying down the programme of the competition for the Volta prize in 1887:—Whereas at the commencement of this century the Volta pile was looked upon as the most admirable of scientific instruments, by means of which, with or without the assistance of new sources of electricity that have been discovered later on, electricity has given to the applications of heat the highest temperatures, to those of light foci of an intensity that surpasses the intensity of all artificial lights, to the chemical arts a force which becomes useful in galvanoplastics and in the working of metals, to physiology and practical medicine instruments of great efficiency; whereas it has brought into being electric telegraphy and telephony; whereas this pile forms the most delicate, and in some respects, the most powerful mechanical agency, and has become, or seems likely to become, the most powerful of industrial agencies; and whereas it is thenceforth most essential that the scientists of all nations should be called upon to compete together in developing the most useful applications of electricity; the Minister of Public Instruction and Fine Arts orders as follows: (1) In December, 1887, will be awarded the prize of 50,000f., founded by the decree of June 11, 1882, in favor of the author of the discovery by which electricity is to be made economically available for one of the following purposes, viz., as a source of heat, of light, of chemical action, of mechanical power, as a means of transmitting despatches or of treating diseases: (2) Scientists of all nations are to be eligible as competitors; (3) The competition is to remain open until June 30, 1887; (4) The Minister of Public Instruction is to appoint a committee to examine the discovery specified by each of the competitors, and to ascertain whether it complies with the programme of the competition; (5) The report of this committee is to be published in the *Journal Officiel*.

—— THE *Boston Herald* says: It is proverbial that discoverers of valuable inventions rarely reap the profits of their own genius, and there came near being a forcible illustration of the rule, in this city, the other day. Some six months ago an humble electrician in this city, devised a couple of chemical batteries which, he claimed, were superior and cheaper than anything which had been heretofore produced in the electrical branch of science. One of them was a gravity battery with a closed circuit, calculated to work all kinds of telegraph lines, fire alarms included; and the other was a carbon battery, intended for railroad and other signals, annunciators, telephones, electric gas lighting, etc. The attention of the Western Union officials in New York was called to both inventions after they had been duly patented, but they treated them with apparent indifference. In the meantime the inventor formed the acquaintance of a well-known ex-city official, who in turn consulted a prominent lawyer and expert in electrical matters concerning the inventions. They realized at once that the discovery was a valuable one, and immediately a small company was organized for the manufacture of the batteries. The gravity battery was discovered to be so superior and economical that it was immediately adopted, to the almost total exclusion of others, by the fire departments of Boston, Somerville, Malden, Medford, Lynn and Providence, and it is also undergoing satisfactory experiments in New York and other cities. Furthermore, during the same period, it was tested for general telegraphic purposes, and found to be so superior, both in a working and saving sense, that the Western Union Telegraph Company suddenly began to take not only a lively interest in the matter, but undertook to buy out the whole company. The carbon battery had in the mean time been successfully developed, and adopted for signaling purposes on many of the leading railroads of the country, and by one of the leading electrical gas lighting companies. Without realizing the value of his discoveries, the inventor came near selling them out to the Western Union, and if the company had been successful in its negotiations it would have secured in the gravity battery, for a mere song, an invention which an expert electrician has estimated would be a saving on battery account of nearly $1,000,000 a year. Pending the consideration of terms, the telegraph company is using the battery in an experimental way in New York, and the discoverer is dreaming of palaces and marble halls.

—— THE SCARCITY OF GENTLEMEN at a neighboring summer resort was so apparent that a Boston lady telegraphed to her husband: "George, bring down a lot of beaus for the hop this evening." Thanks to the telegraph manipulator, George arrived with a "pot of beans."—*Boston Courier*.

—— ALL ON ACCOUNT OF THE OPERATORS' STRIKE.—To illustrate how easily any one can be a telegraph operator, the Philadelphia *News* gives these as specimens of the way messages are transmitted at one Western Union office in that city: "60 Anters Hotel" for "Planters' Hotel;" "A. L. Legpenny" for "Allegheny;" "Dr. Excelsior, No. 34 South 3d street," for "Drexel & Co.;" "Cog in paste" for "Come in haste;" "66 Casco, Phila." for "P. P. Car Co., Phila.;" "Elbow car" for "E. L. box car." Among the blundering despatches of the strike was one sent by a Long Branch hotel keeper for five hundred loaves of bread and two hundred pounds of coffee. It was replied to by a brief message: "Will send your bread, the coffee is on the way." The despatch as sent read: "Your brother is dead, the coffin is on the way." It is added that a hearse waited at the Long Branch railway depot that night, and the inn-keeper's family were there, in two carriages, in half mourning.

—— ARTICLES OF INCORPORATION were filed, Aug. 22d, with the Secretary of State, at Albany, of the Electrical Conduit Construction Company, with a capital stock of $1,000,000, divided into 100,000 shares. The incorporators are H. W. Pope, Vice-President of the Manhattan District Telegraph Company, of New York; A. B. Chandler, of the Fuller Electrical Company, of New York; H. W. Fairbanks, Superintendent of the Postal Telegraph Company; C. A. Brown, Manager of the Western Electric Company; S. F. Kneeland, of New York; Prof. Elisha Gray, and D. N. Hurlbut, of Chicago. The object of the company is the construction of underground telegraphs and telephones, which, under the patents owned by the company and endorsed by the most eminent and practical telegraphers, can be done with greater economy than by any device yet known. The inventor is D. N. Hurlbut, a well-known telegrapher, of Chicago.

—— WHILE AN ORGAN GRINDER was turning out discords on Fifth Avenue, with an evident purpose of compelling those who "know the value of quiet and happiness" to hire him to move on, the financial agent of the concern climbed a telegraph pole and broke his cord. If the telegraphers' strike had been unanimous, no one knows how long the monkey would have resisted the invitation to come down and have the "missing link" (in his chain) repaired, but in climbing around the cross bars, he made a cross from one wire to another, and was evidently much disturbed by the succession of shocks which he received. His feelings may be expressed in a revised version of the old rhyme:

If I am Darwin's granpa,
Why then, don't you see
That what's a shock to man and beast
Is a double shock to me.

Feeling that it was no place for him, he came down as willingly as Davy Crockett's coon.

—— THE VICKSBURG (Miss.) *Herald* records a remarkable death by lightning at Point Coupee. Mr. George Claiborne, postmaster at that place, started the other evening for a steamboat at the landing, followed at a short distance behind by two negro men on mules, carrying the mails. When nearly to the boat he was seen to fall to the ground suddenly, beneath a white blaze of light that hovered around him for an instant, and the two negro men at the same time were hurled off their mules to the ground. Those on the boat who witnessed the phenomenon rushed ashore, and, almost at the same moment, the two negroes recovered their feet, and came up to where Mr. Claiborne had fallen. They found him a corpse, black as ink all over. An examination of the body disclosed the fact that the electric fluid had penetrated the body in two currents, penetrating his right and left breasts respectively, and making two apertures where they entered, as bullets would have made. A lot of silver coins in one of his pockets were melted and fused together. The sun was shining in an unclouded sky at the time. Some weeks ago two men were similarly killed under a tree at Bay St. Louis, being struck dead by lightning while the sun was shining.

BUSINESS ADDRESSES.

Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Bradford, C., Solicitor of American and Foreign Patents, 16 & 18 Hubbard Block, corner Washington and Meridian Streets, Indianapolis, Ind.

Burnap, W. H., Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q., Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Fairman, James F., Telephone, Telegraph, and Electric Light Supplies, and Apparatus, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

Wenzel, A. C., Electro-plater—Gold, Silver, Nickel, Copper, Brass, &c., 43 Centre Street, New York.

BERLY'S
Universal Electrical Business Directory
—AND—
ADVERTISER, FOR 1883-4.

Revised and Enlarged, will issue late this Fall, in London, for 1883-4. Price, **$3.00.** Subscription List open. Copies of 1882-3 edition, **$2.50.** Advertisements and cards still received. Address,

CUMMING & BRINKERHOFF, Gen'l Agents,
219 East 18th St., New York.
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IRON
TOWERS AND MASTS
FOR ELECTRIC LIGHTS.
Any Height from 50 to 300 Feet.
PRICES FROM $85.00 UPWARDS.
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BUSINESS NOTICES.

WE call attention to advertisement, in another column, of G. S. Bowen, of Elgin, Ill., who is prepared to furnish Electric Light Towers at the following rates:—Plain Mast, 50 foot, $85; Arm Mast, $112.50, deliverable on board the cars in Chicago, New York, or Boston.

CURT W. MEYER, of No. 11 Dey St., N. Y., whose advertisement appears on another page, has recently fitted up a variety of new electrical instruments, inclosed in a neat and substantial cabinet, with a book of instruction for the use of teachers and students as a guide to self study and actual experimenting. Price, $15.

THE PARKER GAS ENGINE.

WE would direct attention to the advertisement, in another column of this journal, of Halcyon Skinner & Co., sole manufacturers of the Parker Gas Engine for the United States. This engine is the one described in our last issue, in connection with the Yonkers Fuel Gas Works, and we are gratified to know that orders to supply it can be promptly filled.

I. W. COLBURN & Co., of Fitchburg, Mass., besides manufacturing their regular style of lighting and plating machines, have recently got out a very compact and powerful experimental dynamo machine, designed for professors in schools and colleges for class-room experiments. This dynamo is arranged to be operated by one or two men as desired, and furnishes current of sufficient power to operate three or four incandescent lamps. Parties in want of an electric generator for any purpose will do well to write to the above-named company before placing their orders elsewhere.

THE electricians of Providence have not only refused to allow their telephone interests to be swallowed by the New England combination, but show great vitality by entering the broad field of electric work of every description, excepting that of electric lighting. Their new combination is styled the "Rhode Island Telephone and Electric Co.," which owns several valuable patents for switch boards and other appliances. This company makes quite an innovation in taking under its fostering care the heretofore much abused lightning-rod business, and propose to redeem it from the foul reputation of the itinerant "*lightning-rod man.*" Parties employing them may feel confident of having their work well done, and on scientific principles. Their office is at 30 and 31 Butler Exchange, Providence, R. I.

The Electric Storage and Light Co.,

Organized under Laws of Massachusetts,

own the Patents for

FAURE'S STORAGE BATTERIES

—: OR :—

Electrical Energy Accumulators,

—: FOR :—

Massachusetts, Rhode Island, and Connecticut.

Office, 95 Milk St., Boston, Mass.

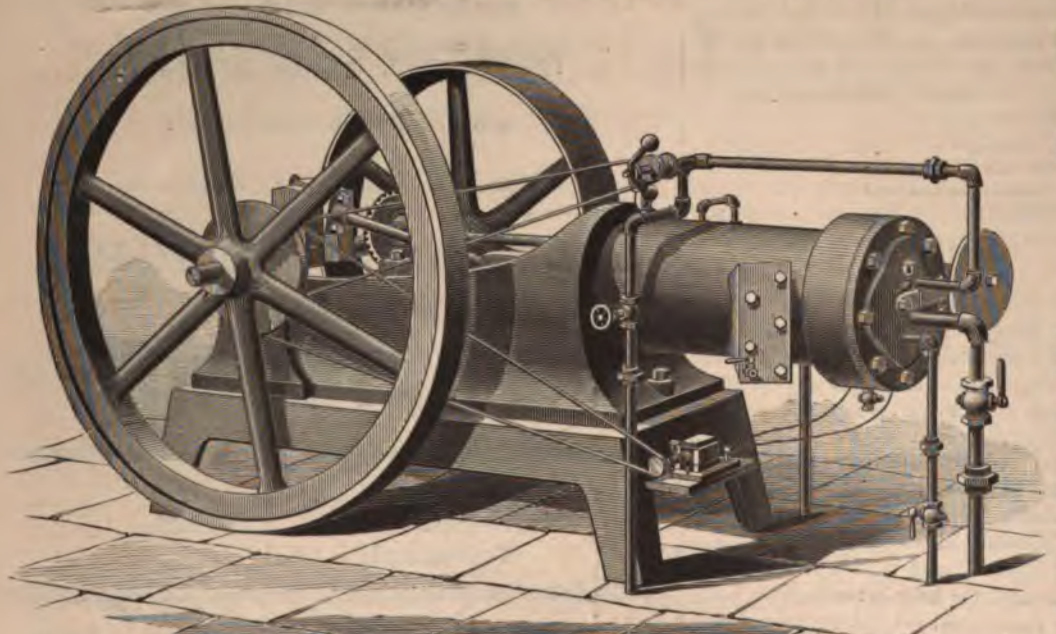
Prof. Curt W. Meyer's Electrical Cabinet, with Elementary Guide in Electricity, consists of electrical glass plate machine, with conductor; Leyden jar and discharger; electrical cannon; ball electrometer; head of medusa; set of bells; electrical orrery; chain; box of amalgam; all contained in a neat case, for **$15.00.**

ALL KINDS OF EXPERIMENTAL APPARATUS FOR SCHOOLS.

Address for circular,

CURT W. MEYER, 11 Dey St., N.Y.

THE PARKER GAS ENGINE.



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The Most Economical and Efficient Gas Engine Now in Use.

Will be made in such sizes and numbers as may be required. It is especially adapted to producing the electric current, either for electric motors, running the electric light, or charging storage batteries.

It is ignited by the electric spark, by means of a small dynamo, run by the engine itself, and is absolutely dangerless, not even a match being required to light it.

It can be run either with ordinary illuminating gas, or fuel gas.

A four-horse working model can be seen in the Yonkers Fuel Gas Works.

For further information, prices, &c., apply to the

YONKERS MANUFACTURING CO., Sole Builder for the United States,

No. 3 NEPPERHAN STREET, Near the Depot,

YONKERS, N. Y., August 20th, 1883. **CHAS. E. SKINNER, Agent.**

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MANUFACTURERS OF
SHEET BRASS, BRASS WIRE, RODS AND TUBING, COPPER RIVETS AND BURS,

Pure Lake Superior Copper Wire

FOR ELECTRICAL PURPOSES.

INSULATED ELECTRIC LIGHT
: AND :
Patent "K K" Insulated Copper and Iron Wire.
The Iron is Specially adapted for Telephone Use.

No. 49 CHAMBERS ST.,
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No. 506 COMMERCE ST.,
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No. 18 FEDERAL ST.,
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EQUITABLE

LIFE ASSURANCE SOCIETY.

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No. 120 BROADWAY, New York.

JANUARY 1, 1883.

(On 4½ per cent. Basis.)		(On 4 per cent. Basis.)	
Assets, -	**$48,025,751**	**Assets, -**	**$48,025,751**
Liabilities,	**37,367,076**	**Liabilities,**	**39,949,454**
Surplus, -	**$10,658,675**	**Surplus, -**	**$8,076,296**

RATIO of Surplus to Liabilities of the leading life insurance companies on a four per cent. basis:

	ASSETS.	LIABILITIES.	SURPLUS.	RATIO.
EQUITABLE	$48,025,751	$39,949,454	$8,076,296	20.21
NEW YORK	50,800,396	43,760,183	7,040,213	16.09
MUTUAL, N. Y.	97,961,317	93,349,903	4,611,414	4.94

The amount of New Business transacted in 1882 by the Equitable Life Assurance Society exceeded the largest business ever done by any company in one year.

INDISPUTABLE INSURANCE
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PROMPT PAYMENT OF CLAIMS.

The Equitable having declared its policies, over three years in force to be **Indisputable,** will pay all such indisputable policies at maturity, without rebate of interest, immediately after the receipt at the Society's office in New York, of satisfactory proofs of death, together with a valid and satisfactory discharge from the parties in interest.

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Foreign Patents procured. Opinions given on questions of validity and infringement. Our Quarterly Circular, **"Patents on Inventions,"** will be sent to any one desiring it.

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PHOTO-LITHOGRAPHING IN THE BEST STYLE
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NEW YORK.
Estimates and Specimens furnished on Application.

PATENTS FOR JULY AND AUGUST, 1883.

JULY 24th.

282,016	Annunciator and Fire Alarm, Electric. S. Van Benschoten, Brooklyn, N. Y., and H. H. Johnson, Hackensack, N. J.
281,931	Electric Call Apparatus. C. S. Shivler, Brooklyn, N. Y.
281,799	Electric Circuits, Automatic Cut-out for. R. J. Sheehy, New York, N. Y.
281,800	Electric Light Regulator. R. J. Sheehy, New York, N. Y.
281,985	Electric Machine, Dynamo. E. A. Edwards, Cincinnati, Ohio.
281,904	Electric Machine, Dynamo and Magneto. J. M. McMahon, Jersey City, N. J.
281,937	Electric Switch, Automatic. H. W. Spang, Reading, Pa.
281,722	Electrical Conductors, System of Laying Subterranean. W. R. Patterson, Chicago, Ill.
281,680	Fire Alarm and Call Bell System, Electric. C. H. Frank, Amsterdam, N.Y.
281,841	Insulated Electric Conductor. A. A. Cowles, New York, N. Y.
281,864	Insulated Electric Conductors, Manufacture of. J. F. Gilpin, Ansonia, Conn.
281,999	Insulating Compound for Electrical Conductors, and Apparatus for Compounding and Applying the same. J. B. Hyde, New York, N. Y.
281,698	Lamp, Electric arc. N. S. Keith, New York, N. Y.
281,891	Lamp, Electric-arc. J. Lea, London, County of Middlesex, England.
281,723	Lightning Arrester for Electric Wires. W. R. Patterson, Chicago, Ill.
281,672	Railway, Electric. F. B. Crocker, C. G. Curtis and S. S. Wheeler, New York, N. Y.
281,839	Railway Pneumatic Switch and Electric Indicator. C. A. Cooper, Pittsburg, Pa.
281,884	Tele-thermoscope, Electric. W. S. Johnson, Whitewater, Wis.
281,788	Telegraph, Automatic Printing. F. Ostrogovich, Florence, Italy.
281,741	Telephone Exchanges, Spring-jack Switch for. J. C. Warner, Chicago, Ill.
281,895	Telephone Lines, Transmitting Apparatus for. T. D. Lockwood, Malden, Mass.
281,877	Temperature Indicator, Electric. R. Hewitt, Jr., New York, N. Y.
281,859	Vehicle Propelled by Electricity. E. Fox, Brooklyn, N. Y.

JULY 31st.

282,246	Bell Pull, Electric. F. J. Wall, Lawrence, Mass.
282,165	Despatch Tube, Electro-magnetic. C. A. Cheever, New York, N. Y.
282,317	Electric Light Brackets, Joint for. C. H. Hinds, New York, N. Y.
282,318	Electric Light Joint. C. H. Hinds, New York, N. Y.
282,446	Electric Machine, Dynamo. S. Z. De Ferranti, Richmond Gardens, Shepherd's Bush, County of Middlesex, England, and A. Thompson, Guildford Place, Russell Square, County of Middlesex, England.
282,459	Electric Machine, Dynamo. E. R. Knowles, Brooklyn, N. Y.
282,187	Electric Machines, Automatic Regulator for Dynamo. F. S. Giel, Brooklyn, N. Y.
282,158	Electricity, Apparatus for Lighting Cars by. G. D. Burton, New Ipswich, N. H.
282,043	Gas Burner, Electric Lighting. A. L. Bogart, Jamaica, N. Y.
282,461	Lamp, Electric-arc. E. R. Knowles, Brooklyn, N. Y.
282,157	Lamp Globe, Electric. G. D. Burton, New Ipswich, N. H.
282,030	Lamp, Incandescent Electric. I. Adams, Jr., Boston, Mass.
282,460	Lamp, Incandescent Electric. E. R. Knowles, Brooklyn, N. Y.
282,472	Lamps, Manufacture of Incandescent. A. Swan, Gateshead, County of Durham, England.
282,449	Lightning Rod. T. H. Dodge, Worcester, Mass.
282,287	Magneto-electric Signaling Apparatus. T. A. Edison, Menlo Park, N. J.
282,447	Measuring Electric Currents, Apparatus for. S. Z. De Ferranti, Richmond Gardens, Shepherd's Bush, County of Middlesex, England, and A. Thompson, Guildford Place, Russell Square, County of Middlesex, England.
282,073	Ore Separator, Electric. H. Greve, St. Paul, Minn.
282,229	Railway Electric Signal Apparatus. C. A. Scott, Boston, Mass.
282,230	Railway Electric Signaling Apparatus. C. A. Scott, Boston, Mass.
282,396	Secondary Battery. E. T. Starr, Philadelphia, Pa.
282,428	Secondary Battery Indicator. E. Weston, Newark, N. J.
282,414	Secondary Electric Battery. C. J. Van Depoele, Chicago, Ill.
282,297	Telegraphs, Dynamo-electric Machine for Printing. S. D. Field, New York, N. Y.
282,294	Telegraphy, Dynamo. S. D. Field, New York, N. Y.
282,295	Telegraphy, Dynamo. S. D. Field, New York, N. Y.
282,296	Telegraphy, Dynamo. S. D. Field, New York, N. Y.
282,431	Therapeutic Apparatus, Electro. A. W. K. Andrews, Binghamton, N. Y., and C. R. Teed, Syracuse, N. Y.

AUGUST 7th.

282,921	Electric Circuit Breaker. S. M. Plush, Philadelphia, Pa.
282,833	Electric Conductor Conduit. L. Bannister, Philadelphia, Pa.
282,791	Electrical Indicators, Unison Mechanism for. F. H. Snell, Washington, D. C.
282,784	Galvanic Battery. E. F. Schlosser, Hoboken, N. J.
282,890	Gas Burner, Electric. C. H. Hinds, New York, N. Y.
282,816	Gas Lighting and Extinguishing Device, Electric. L. S. White, Waterbury, Conn.
282,914	Insulators, Compound for Electric Wire. J. F. Martin, Chicago, Ill.
282,521	Lamp Fixture or Bracket, Electric. C. W. Holtzer, Brookline, Mass.
282,861	Lamp, Incandescent Electric. P. R. D. D'Humy, Carleton Mansions, Clapham Rise, County of Surrey, England.
282,534	Lamp, Incandescent Electric. E. R. Knowles, Brooklyn, N. Y., and F. E. Idell, Hoboken, N. J.
282,884	Lamps, Manufacture of Incandescent Electric. J. H. Guest, Brooklyn, N. Y.
282,562	Lightning Rod. T. H. Patee, Greencastle, Ind.
282,489	Telegraph Pole. T. Breen, Knowlton, Pa.
282,680	Telephone and Telegraph Wires, etc., Machinery for Covering. J. A. Sparling, London, County of Middlesex, England.
282,841	Telephone Cabinet. R. Busteed, Brooklyn, N. Y.
282,699	Telephone Central Office Apparatus. W. M. Brock, Shamokin, Pa.
282,867	Telephonic Circuit. W. H. Eckert, and J. A. Seely, New York, N. Y.

AUGUST 14th.

283,355	Electric Battery. C. P. Orm, Cambridge, Mass.
283,152	Electric Circuit Track Instrument. C. A. Scott, Boston, Mass.
283,167	Electric Commutator or Switch. E. Thomson, New Britain, Conn.
283,343	Electric Machine, Dynamo. E. J. Houston, Philadelphia, Pa.
283,155	Electric Machine Regulator, Dynamo. R. J. Sheehy, New York, N. Y.
283,044	Insulate, Preserve and Protect Wire for Electrical Purposes, Composition to. D. B. Turner, Chicago, Ill.
282,989	Insulators, Apparatus for Making Glass. M. Johnson, Ellenville, N. Y.
283,186	Lamp, Electric. F. Bain, Union City, Ind.
283,168	Lamp, Electric. E. Thomson, New Britain, Conn.
283,042	Lamp, Electric-arc. W. M. Thomas, Cincinnati, Ohio.
283,270	Lamp, Incandescing Electric. S. D. Mott, Menlo Park, N. J.
283,166	Roof, Insulated Metallic. H. C. Thomas, Rock View, N. Y.
283,295	Secondary Battery. E. T. Starr, Philadelphia, Pa.
283,073	Speaking Tubes, Electrical Indicator for. J. Capron, New York, N. Y.
283,231	Switch and Signal Levers, Electric Locking Mechanism for. O Gassett, Boston, Mass.
283,140	Telegraph Lines, Ground Wire Clamp for. H. W. Pope, Elizabeth, N. J.
282,969	Telephone. C. Egan, Zanesville, Ohio.
283,334	Telephone Central Office Apparatus. L. B. Firman, Chicago, Ill.
283,312	Telephone Lines, Spring-jack and Circuit for Through. C H. Wilson, Chicago, Ill.
283,354	Telephone Local Call Instrument. W. Nichols, Boston, Mass.
283,062	Telephone, Speaking. F. Blake, Jr., Weston, Mass.
283,123	Telephone Transmitter. W. C. Lockwood, Brooklyn, N. Y.
282,964	Tin from Tin-scrap by Electricity, Removing. J. L. Delaplaine, J. G. Hendrickson, F. J. Clamer, Philadelphia, Pa.
283,200	Wires, Composition for Coating and Insulating Underground. H. R. Brissett and J. Howe, Tyngsborough, Mass.
283,590	Annunciator, Electric. E. Flint, Jr., Boston, Mass.
283,433	Electric Conductor. H. D. Stanley, and G. Doolittle, Bridgeport, Conn.
283,498	Electric Machine, Dynamo. A. M. Loryea, and C. H. Palmer, New York, N. Y.
283,548	Electric Machine, Dynamo. E. Weston, Newark, N. J.
283,624	Electric Machines, Armature for Dynamo. J. T. Listen, Cleveland, Ohio.
283,547	Electrical Meter. E. Weston, Newark, N. J.
283,736	Electrical Signaling Device. W. S. Johnson, Washington, D. C.
283,546	Electro-magnetic Motor. E. Weston, Newark, N. J.
283,482	Lamp, Electric. C. D. Haskins, New York, N. Y.
283,629	Lamp, Electric. H. S. Maxim, Brooklyn, N. Y.
283,437	Lamp, Electric. E. Thomson, New Britain, Conn.
283,662	Lamp, Electric-arc. C. Richter, Camden, N. J.
283,655	Telegraph, Automatic. J. W. Rogers, New York, N. Y.
283,716	Telegraph Transmitter. H. Lyon, New York, N. Y.
283,626	Telephone Exchanges, Signaling Apparatus for. T. D. Lockwood, Malden, Mass.
283,492	Telephonic and Telegraphic Instruments, Apparatus for Protecting. F. E. Kinsman, New York, N. Y.

AUGUST 21st.

283,590	Annunciator, Electric. E. Flint, Jr., Boston, Mass.
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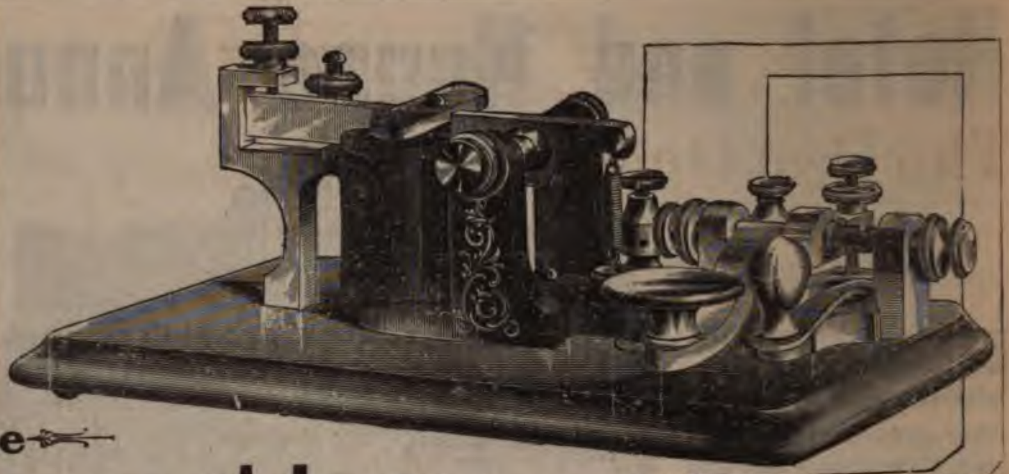

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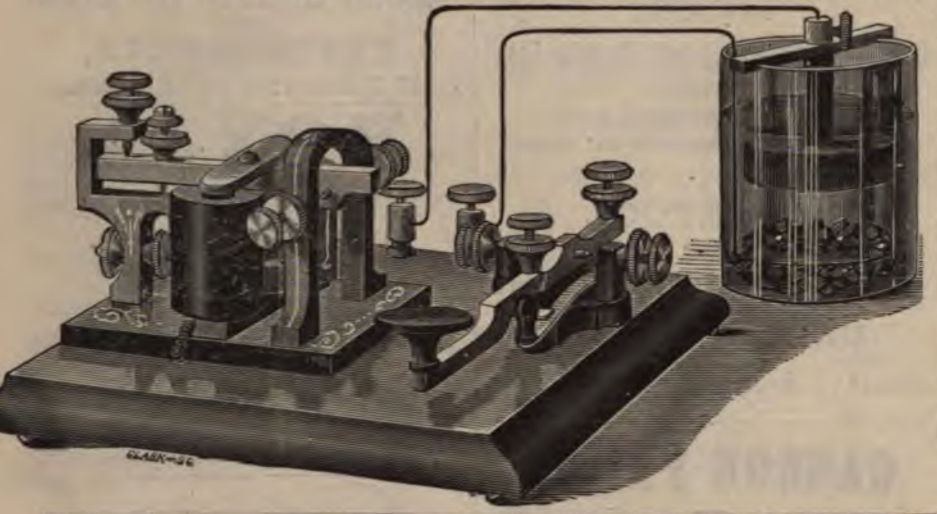

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Vol. II. No 10.] OCTOBER, 1883. [$1.00 a Year. 10 Cents a Copy.

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PHOTOGRAPHY IN MEDICINE.

PHOTO-ELECTRIC APPARATUS.

SINCE the introduction of the new gelatino-bromide of silver-process, photography has reached some serious results. Motion, which has been so long an obstacle to it, is so no longer, but on the contrary, it is sought, to give more of life, more of reality to the subjects that it is desired to reproduce. In fact, it may go still further, and decompose, or analyze. The horse cannot run or the bird fly rapidly enough to escape the apparatus of Messrs. Muybridge and Marey, the interesting results of which are now known to all the world.

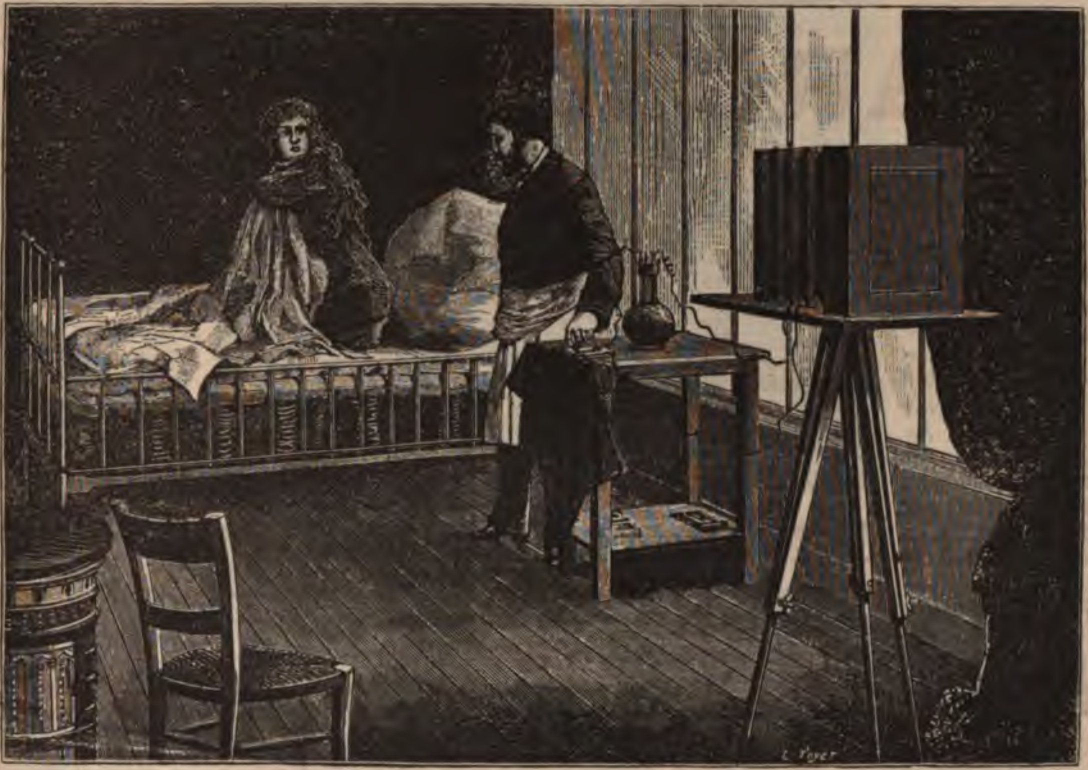

FIG. 1.—ARRANGEMENT OF THE PHOTO-ELECTRIC APPARATUS FOR MEDICAL OBSERVATION. THE PHYSICIAN, LOCATED NEAR THE PATIENT, OPERATES THE CAMERA AT A DISTANCE BY MEANS OF ELECTRICITY.

In the face of such results, it is not astonishing to see photography enter, in various ways, the domain of science, and take therein an important place.

The present article, for which we are indebted to *La Nature*, is designed "to indicate to our readers the principal applications of photography in connection with the study of medicine."

Most of the hospitals, at the present time, possess a photographic service. It takes its place now in all the laboratories where precise records are required for future reference.

One of these laboratories is particularly conspicuous; it is that of "La Sal Petrière," due to the initiative of Professor Charcot. We take it as a typical example, since it receives a certain class of patients who necessitate the employment of special apparatus which we will presently describe.

Upon entering the hospital, the patient is photographed, and the proof thus obtained serves as a basis for comparison with the observed transformations which subsequently appear in the patient's condition. In the case of hysterical contractions, for instance, it is interesting not only to preserve the form of the primitive contraction, but to note with care the changes which occur. The different photographs are collected in an album, and present, at a glance, a historical review of all the series of phenomena which the case has presented in a given time.

By comparison of proofs of various instances of the same disease, interesting data are observed. In his clinical lectures, during 1883, Professor Charcot insists especially upon this point in connection with "sclero dermie."

The modern processes, such as photo-lithography, which permits of the transformation of any impression into a typographic plate, gives great value to these collections. In point of fact, such reproductions, combined with observations, theses, and medical publications, may be universally accessible, to the great advantage of science and instruction. But the greatest advantage of medical photography is, that it furnishes transparent positives on glass, which, under the name of projections, enable the professor to keep before his audience accurate illustrations of the subject under discussion. Thanks to the rapid progress of photography, this method of teaching by the eyes, the value of which is recognized as beyond discussion, is gradually extending more and more widely.*

Should the patient die, the anatomist preserves the aspect of the affected organs, before cutting them up for microscopical examination.

In this connection appears a most important application of photography, namely, photo-micrography. It is well known, and to the histologist better, perhaps, than to others, that the microscopical sections which we so much admire, are liable to destruction. Some change, others can be easily broken or lost, and it is desirable to preserve them. Photography permits this to be done, not only in a durable manner, but presents them in a form to facilitate researches and studies.

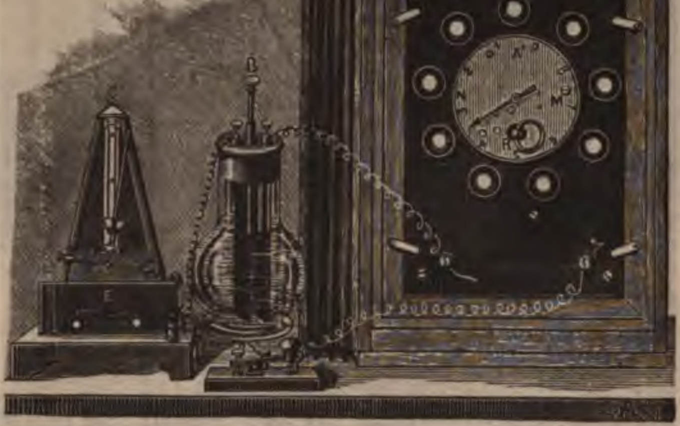

FIG. 2.—PHOTO-ELECTRIC APPARATUS, ARRANGED TO TAKE A SERIES OF IMPRESSIONS AT EQUAL INTERVALS OF TIME.

A, Photographic Camera; *B*, Battery; *C*, Metronome; *A'*, Clock Movement; *R*, Key for same; *D*, Morse Signal Key; *E*, Trough of Mercury.

They may be enlarged, collected and published, and they need no longer be kept guarded in laboratories, to the great disadvantage of persons occupied with a study of medicine.

To resume. A photographic service especially directed to the needs of medical study, must, in addition to the current applications of photography, include a set of micro-photographic apparatus. The stereotype plates and lantern transparencies should be carefully classified. Albums, containing the proofs from nature and micrographic enlargements, are preserved, and present all the indications of nature to guide the student who consults them.

Such are the principal applications of photography, but these are not all. As we mentioned in the beginning, photography may analyze movements; and in this connection, what field of study could be more beautiful than that of medicine? If certain patients are rendered incapable of moving, others are afflicted with an exuberance of movements. I speak here of individuals attainted with certain diseases of the nervous system, such as hystero-epilepsy, the epilepsy proper, etc., etc.

The spasms that we have more especially in view, far from being an incongruous mixture of disorderly movements, are subject, on the contrary, to certain rules and certain laws. If we take, as a type, the hystero-epileptic attack, we shall see, as Prof. Charcot has demonstrated, that it is composed of perfectly distinct periods, each of which comports with a succession of rhythmic and characteristic movements. What is necessary, then, is an apparatus which permits, first, to seize upon the different special attitudes at various periods; second, to decompose the movement during each period in a series of separate proofs taken at intervals very near together.

To this end we project a series of views of the same object in a circle within the camera by a circle of objectives upon its front. A blackened disc of aluminum, pierced with a rectangular opening, and revolved by a clock movement, is placed behind the objectives. While at rest, the opening in the disc remains between two objectives, and consequently the sensitive film is entirely protected from the light. An electro-magnet controls a mechanism so arranged that when a momentary current passes, the opening in the disc moves over and opens one of the objectives, remaining fixed over the opening until the current is interrupted, when it again moves onward, but stops before reaching the next objective and again excludes all light. The advantage of this disposition is evident. So long as the current passes, one of the objectives acts, which is a condition necessary in a laboratory. So long as the current is interrupted the apparatus is closed. The time of exposure, and the interval between two successive proofs, can, therefore, be graduated at pleasure. A needle upon the exterior of the camera follows the movement of the disc, and indicates the number of impressions taken. Electricity being the regulator of the apparatus, the observer can operate it at a distance while remaining at the bedside of the patient. The accompanying engraving, Fig. 1, shows the general installation of the apparatus at the moment of the experiment. The doctor, by means of a Morse key, sends a current of electricity to the camera at pleasure, and thus preserves the attitudes that he wishes to study. It is thus that may be obtained impressions characterizing each period. When it is desired to decompose a movement within a period, a Breguet key may be employed, or better still, a transmitting cylinder, to which the desired rapidity may be given by means of a regulator. This cylinder, made of insulating material, has a series of long metallic triangles imbedded in its surface, and all communicating with the poles of a battery. During its rotation a contact point, which can be moved parallel to the cylinder, receives the current each time one of the triangles passes, and transmits it to the apparatus. Towards the extremity of a triangle the pose will be evidently short, near its base it will be proportionately longer. If, therefore, the cylinder be given a rotation, of known duration, it is easy to take photographs at determined intervals and of determined exposures. The movement being decomposed, it may be easily reconstituted by means of the phenakisticope.

Messrs. Muybridge and Marey originated this study of movements, the first by means of distinct apparatuses arranged in series; the second by means of his photographic gun. For our own part, and for the generality of the studies which interests us, we prefer the system of multiple objectives.

The expense of many objectives is certainly considerable, but other considerations induce us to regard this as of secondary importance.

Fig. 2 shows a front view of the camera and the arrangement of objectives, but this is only a model apparatus suitable for experimental purposes. It is desirable to have it made on a scale sufficiently large to give pictures of the usual size for projection. There is no limit to the size of the instrument. One of its advantages is, that it will give several pictures at the same time. In effect the disc may be rotated with as great rapidity as may be desired.

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* An excellent example of its efficacy is seen in Prof. Bickmore's Saturday morning lectures on Natural History, at the Am. Mus. of Nat. Hist., N. Y.

In the gun barrel of our esteemed friend, Professor Marey, the revolution of the chamber which contains the sensitive plate, occupies one second of time, during which 12 pictures are made, each with $\frac{1}{750}$ of a second exposure. All the attitudes intermediate between two pictures being lost. This is a necessary defect of the device which presents before a single objective different parts of the same sensitive plate, and permits the light to enter only when the plate is immovable. Much time must, therefore, be lost during the experiment.

In the system of multiple objectives, each objective is independent, and the lost time is greatly reduced, since the opening of the disc—however rapidly it may be moved forward—finds each objective ready to operate.

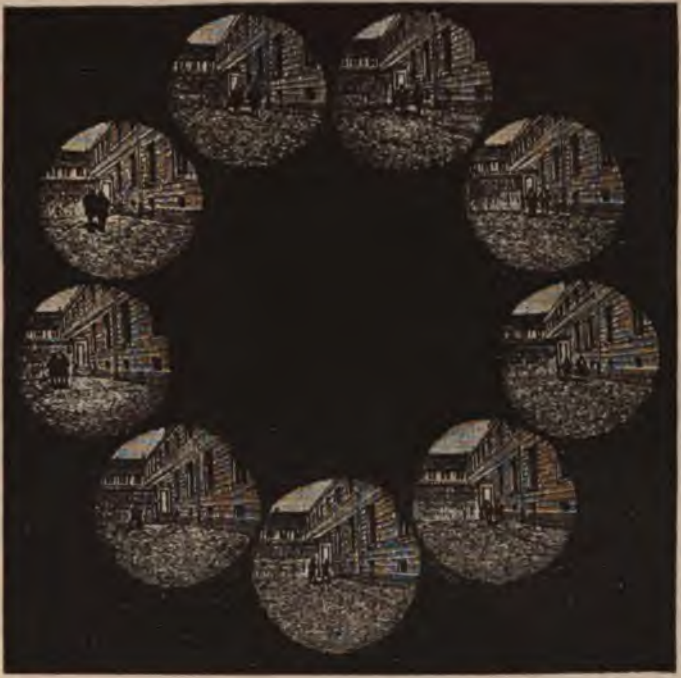


FIG. 3.—IMPRESSIONS OBTAINED BY THE PHOTO-ELECTRIC APPARATUS. A SERIES OF PICTURES TAKEN FROM THE SAME OBJECT AT UNEQUAL INTERVALS OF TIME.

Since the size of the camera is unlimited, so is the number of objectives, and in a single experiment any number whatever of pictures may be taken. It is merely a question of the number of objectives.

Before concluding, we should mention a convenient device for obtaining the exposures at *equal* intervals of time. It is the electric metronome of M. Gaiffe. The current from the battery enters and leaves the apparatus by a lever, which follows the movement of the metronome and carries two points, which are alternately plunged in a cup of mercury. From this cup the current passes to the camera. A Morse key is included in the circuit and used as follows: Everything being arranged, the metronome is regulated to the desired speed by means of its adjusting weight. When it has acquired its proper rate of vibration and the moment for exposure arrives, the Morse key is depressed and the current allowed to pass until the needle on the camera dial has reached its point of departure. The current is then interrupted and the experiment is terminated. The apparatus we have described, and that we propose to call photo-electric, is especially designed for certain medical and physiological studies; but in military art it would be exceedingly appropriate to photograph torpedo explosions. In fact, the effect of these weapons is studied by measuring the height and diameter of the jet of water projected upward by their explosion, and the data for the measurement, are a series of instantaneous photographs taken at equal intervals of time by distinct cameras. In practice, this disposition is liable to errors that can be suppressed by employing the photo-electric apparatus, which can be controlled from a great distance, and the rate of which is regulated previously.

In concluding this modest paper, we must suggest that the possibilities of the application of photography to medical study are by no means exhausted. Photography is now employed in other departments of science, to register the most delicate indications of various apparatus of observation, and it is not too much to expect that it will soon do as much in the domain of medicine.

WHEREVER wealth can minister to the highest forms of taste and luxury, there we shall see the incandescent light illuminating art and wealth with that radiant glow which furnishes ample light without the annoying heat of coal gas, or its more pernicious fumes, which injure health and fabrics.

We have seen the brilliancy of the carbon—in the form of the diamond, flashing back its borrowed light—completely eclipsed by the glowing of the other form of carbon in a tiny incandescent lamp, fed from a portable source of electricity concealed by the wearer.

When the general public fully realize how little of the experimental stage yet remains in electric lighting, then we shall see its rapid introduction into the more elegantly appointed homes of our cities. There is little prospect of its use in the isolated suburban residences, as this method of lighting can be furnished feasibly to homes only from central stations, because no one wishes their homes invaded by the apparatus of modern steam engineering, with its boilers furnishing steam at high pressures, even if it were desired to employ competent engineers for the time that the lights are used.

For the present, the sources of such light must be derived from a central station with the electricity transmitted by the heavy underground leads suited for incandescent lighting currents; or perhaps by secondary batteries converting arc lighting currents upon aerial wires to those currents of low tension suitable for incandescent lamps.

It is a curious fact that the electric light is most perfectly suited to the two extremes of use. The one in industrial establishments, where greed of gain demands the abatement of the last cent in every item of expense, and on the other hand, among those homes where the liberal conditions of life receive the tribute of those achievements of industry and art which add to the comfort of life and the enjoyment of the beautiful.

—— M. JACQUELAIN has endeavored to prepare a pure carbon for electric purposes that should be as hard and as conductive as gas carbon. He first takes gas carbon, which he submits to four processes: 1, treatment with dry chlorine at a red heat for thirty hours; 2, treatment with hot alkali for about three hours; 3, immersion in hydrofluoric acid (1 to 2 of water) at a temperature of 15° to 25°; 4, carbonized by heating strongly in the vapor of a high-boiling hydrocarbon, for commercial purposes gas tar will do as well. All these operations may be performed after the carbon has been cut into sticks. By these processes the impurities have been reduced to a minimum, and a good, pure carbon obtained.—*Nature.*

ATKINSON'S TÖPLER ELECTRIC MACHINE, AND ITS MODE OF ACTION.

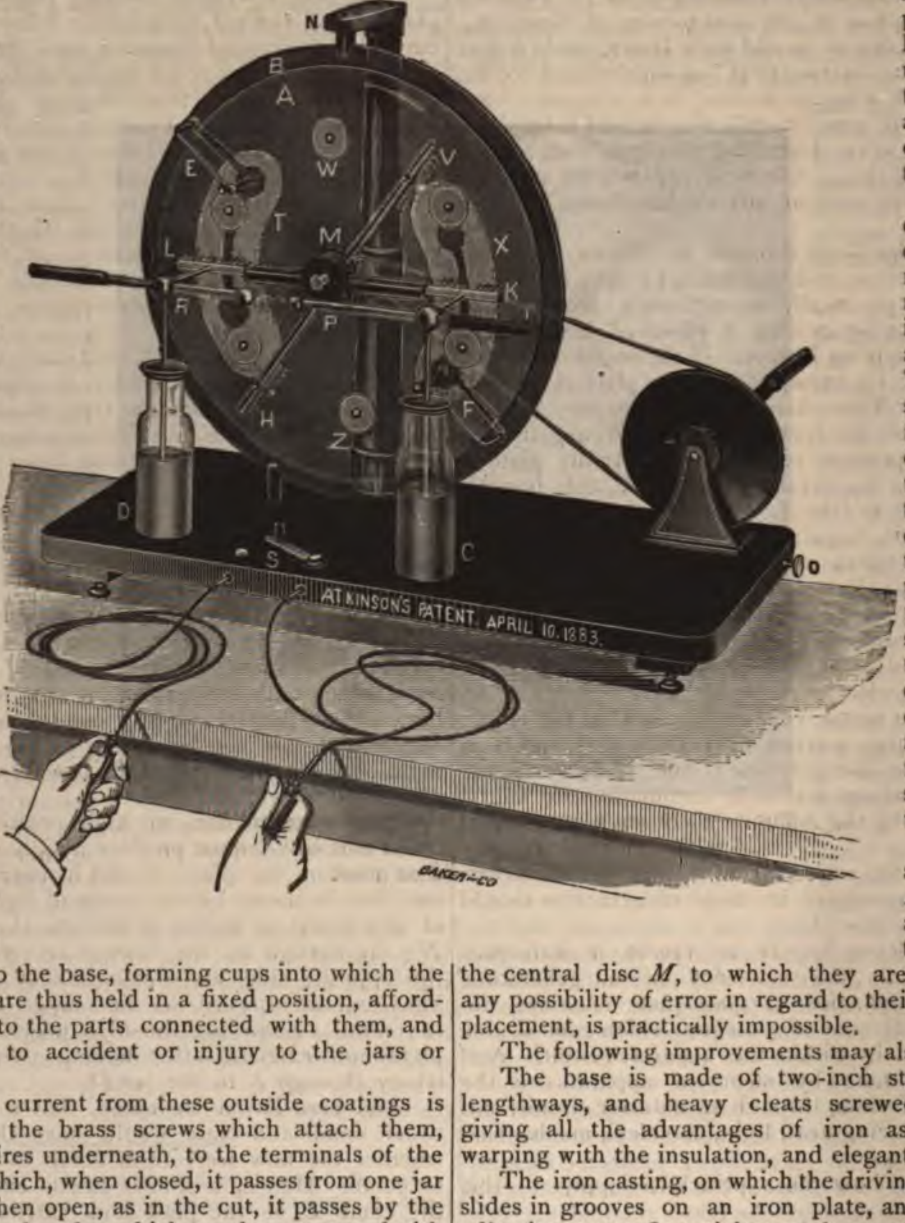
BY P. ATKINSON, A.M.

(For the Electrician.)

CHICAGO, Sept. 14th, 1883.

THIS machine is constructed with two glass plates; the back plate *B*, stationary, and supported by hard rubber insulators, while the front plate *A*, placed at a distance of about ¼ inch from it, revolves in the direction of the arrow, on an axis attached to the post at *M*, through an opening in the centre of the plate *B*.

To the plate *B* are attached the brushes *E* and *F*, and the tin-foil and paper inductors *T* and *X*



In front of the plate *A*, ¼ inch from the glass, are the uninsulated combs *V* and *H*, with their brushes; and the insulated combs *K* and *L*, connected with the Leyden jars *C* and *D*, and the sliding rods *P* and *R*. *V* and *H* are screwed to a brass core at the centre of the hard rubber disc *M*.

To the plate *A* are attached the six discs, or carriers, two of which are seen at *W* and *Z*.

These parts, with a driving wheel and belt, mounted on a base, constitute the points of resemblance between this machine and others of the same class. The points of difference, covered by patent, are as follows:

1. The outside coatings of the Leyden jars *C* and *D*, are of sheet brass, nickel plated, and are screwed firmly to the base, forming cups into which the jars fit closely, and are thus held in a fixed position, affording a firm support to the parts connected with them, and preventing liability to accident or injury to the jars or plates.

2. The induced current from these outside coatings is conveyed down by the brass screws which attach them, and along copper wires underneath, to the terminals of the switch *S*, through which, when closed, it passes from one jar to the other; but when open, as in the cut, it passes by the brass sockets, seen on the edge, which are also connected with the terminals, out through the conducting cords, and a person, or other object, connected with their outer extremities. As this induced current flows simultaneously with the direct current from the inside coatings, the switch and sliding rods place it completely under control of the operator, either for medical or scientific purposes. With the switch open, a slight separation of the electrodes *P* and *R*, produces a smooth, gentle current; this may be increased to any desired strength, a separation of ½ inch producing a current too severe for the strongest nerves. Geissler tubes, attached to the cords, show the beautiful effects of the interrupted current. Also the induced spark below, simultaneous with the direct spark above, is shown when the switch is open about ½ inch, as in cut.

3. The brush holders *E* and *F*, are attached to the plate *B*, through holes near its edge; thus giving a direct passage to the electricity from the carriers on the plate *A*, where it is generated, through the glass, to the tin-foil inductors, represented by the dark shade, and the paper inductors *T* and *X*, represented by the light shade. By passing the electric charge *through the glass, inside its edge*, an insulating margin is interposed between the conductors and the edge, thus preventing loss from leakage, which is unavoidable when the brush holders are attached by clamps or ears *on* the edge.

4. The carriers on the plate *A* are of sheet brass, with raised centres, and nickel plated, making them both durable and ornamental. The hard nickel surface is not affected by the action of the brushes, or the electricity, while tin-foil soon becomes defaced; and the carrier, being practically one piece, and its entire surface cemented to the glass, its raised centre cannot become detached, as may happen when the centre is put on separately over a tin-foil base.

5. The combs *V* and *K*, also *H* and *L*, radiate at an angle of 45 degrees to each other, from the central disc *M*, to which they are attached; so that any possibility of error in regard to their position, or of displacement, is practically impossible.

The following improvements may also be noticed:—

The base is made of two-inch strips, glued together lengthways, and heavy cleats screwed on underneath; giving all the advantages of iron as to freedom from warping with the insulation, and elegant finish of the wood.

The iron casting, on which the driving wheel is mounted, slides in grooves on an iron plate, and is moved by the adjusting screw *O*, to tighten or loosen the belt.

The hard rubber insulators, which support the plate *B*, have soft rubber packing, to ease the pressure on the glass.

The Leyden jars *C* and *D*, have wooden caps, with cork attached, making a neat ornamental cap, and affording a firm support to the brass conducting rods which support the sliding rods *P* and *R*, and the combs *K* and *L*, The machine, as here described, has only two plates; but the number is not limited; four or more plates may be used if desired, but better results have been obtained by increasing the size, rather than the number, of the plates. Plates 16 and 18 inches diameter, respectively, make a very efficient machine; plates 25 and 28 inches diameter, make one of great energy; and the smoothness of the induced current is very perceptible in machines of large size.

The energy of the discharge depends chiefly on the size of the Leyden jars, as increased size gives increased storage, and consequently, greater energy and less rapidity of discharge.

ITS MODE OF ACTION.

Soon after the invention of the Holtz machine, in 1865, an explanation of its mode of action appeared. This was based on the assumption of the dual nature of electricity, and illustrated by a cut of an old style Holtz, made before the application of the "diametrical," or uninsulated combs.

So plausible was this explanation, that scientists have ever since seemed to rest satisfied with it; and it has been copied into every work describing the machine, and, in some cases, with the same identical old cut, or worse, a cut of the new style, without any explanation of the new appliance.

This theory of the Holtz is briefly as follows.—Supposing the carriers, brushes, and uninsulated combs in the cut, removed, we have, practically, an old style Holtz. The initial charge is given by inciting a piece of hard rubber with catskin, and applying it to one of the paper inductors on the plate *B* to *X* for example, while the plate *A* is made to rotate rapidly. This charge being negative, induces positive electricity on the front surface of *B*, negative on the back of A, and positive on the front. As the plate *A* in revolving, passes the insulated comb *K*, the positive charge is given off to the Leyden jar *C*, and negative received. With this negative charge the plate comes round to the other comb and jar, gives up its negative, and receives positive electricity. Thus, opposite sides, surfaces, and jars become oppositely charged, each acting inductively on the other in geometrical ratio; while a discharge, accompanied with spark and snap, takes place between the sliding electrodes.

This explanation seems very satisfactory for the Holtz, where the initial charge is given on one side only, and from a source exterior to the machine; but it fails to explain the Töpler, whose action is automatic, the initial charge being given by the machine itself on both sides at the same instant.

To comprehend the action of any electric generator, the following essential principles in their construction should be kept distinctly in view.

To generate electricity, is to create a difference of electric potential; the efficiency of all generators, whether batteries, dynamos, or glass plate machines, depending on the difference of potential which each is able to create and maintain within the apparatus itself. And the work to be done by such an apparatus is the restoration of equilibrium, through an exterior circuit; and may consist in producing heat, light, chemical, mechanical, or physiological action.

Let us consider how these principles apply to this machine.

It will be seen, from the cut, that as the plate *A* revolves, the raised centres of the six carriers are brought into contact with the wire brushes attached to the holders *E* and *F*, each opposite pair touching opposite brushes, successively, at the same instant. The friction generates electricity, which diffuses itself over the carriers on *A*, and the inductors on *B*, with which they are, at the instant of contact, in electric connection. The potential of carrier and inductor, during contact, will be the same; at the next instant the carrier passes on, and is insulated from the inductor, and carrier and inductor now act inductively on each other, and multiply the initial charge given by the friction of contact. As it accumulates, it spreads over the paper inductors; these act on the opposite surfaces of the glass, till both surfaces of both plates become charged; the initial charge being still continued by the constant friction of the carriers and brushes.

But, since both sides of the machine are of precisely similar construction, and since the mode of action on both sides is apparently the same, the question arises, how any difference of potential, or electric charge can be accounted for.

And first, it will be noticed, that the position of the plates being vertical, their lower halves are nearer to the earth, by their semi-diameter, than the upper halves, and consequently, more under the influence of its inductive action, by the square of that distance. A horizontal, or any other position would not prevent this result; it could only be done by placing them between two worlds of equal size, and equally distant from both.

The lower halves are also in close proximity to the Leyden jars, the driving wheel, and the belt, and subject to their inductive influence; and the plate *B*, is supported on *two* hard rubber insulators, while the upper half has but one, and hence has the advantage of the better insulation of the air.

To this lower half of *B*, and subject to these influences, is attached the brush holder *F*, while *E* is attached to the upper half, and remote from them. Hence, the carriers brushed by *E*, and descending towards *L*, must acquire a higher potential than those brushed by *F*, and ascending towards *K*.

An accumulation of electricity must also occur at the lower ends of the inductors *T* and *X*, from the inductive influence of the earth; and as the brush holder *F*, is placed at the lower end of *X*, it furnishes an outlet to a portion of this charge, as seen at night by the brushes of light from this holder to the outside of the jar *C*, and other parts in close proximity.

The lower end of *T*, on the contrary, is well insulated; hence, the potential of *T*, from the heavier charge at its upper end, and the better insulation at its lower end, must be much higher than that of *X*, where the influences are just the reverse.

This accumulation, or high positive potential at the lower end of *T*, must produce a high negative potential at that point on the plate *A*, and its carriers, as it revolves; and this is shown by the brush of light marking the flow of electricity on to the plate from the uninsulated comb *H*; the outflow of the current received through *V* from the opposite side and upper half of *A*. This brush of light extends upward, as the charge increases, almost to the comb *L*, showing the high negative condition of the plate and carriers, after having parted with their electricity through *L* to the jar *D*.

And here let it be noted, that a brush of light between comb and plate would have the same appearance whether the flow were from comb to plate, or from plate to comb. Hence, a similar brush extends upward from the comb *L*, as the plate and carriers descend charged from *E*, and give off their electricity to *L*.

Following any opposite pair of carriers, as *W* and *Z*, we find that as *Z* passes under the brush *F*, *W* passes under *E*; and as *Z* moves on to the insulated comb *K*, *W* at the same instant arrives at *L*; but *W*, as already shown, has a higher potential than *Z*, and, at this point, a peculiar adjustment takes place. *W* gives up its charge through the comb L, to the inside of the Leyden jar D. This creates a positive charge on the inside of D, which induces a negative charge on its outside. The electricity thus repelled, passes to the outside of C, making it positive, and inducing negative on its inside; and this repelled electricity flows through the comb K to the carrier Z. Z then passes on with a positive charge to the uninsulated comb V, while W, having become negative, as previously shown, arrives at H. Each now passes under the wire brush attached to its respective comb, and the combs being attached to the brass core at the centre of M, the carriers are put in electric connection with each other, and their potential equalized by the flow of electricity from V to H; so that each arrives at the original position of the other at the same potential, ready to repeat the same process.

The combs K and V, L and H, have also performed the same office for the several sections of the plate A, as it has passed them; so that the section from V to E is now at the same potential, from centre to circumference, as the section from H to F; each section having, like the carriers, performed its work on the Leyden jars.

The section from R to H having given up electricity, has become negative, while that from K to V having received electricity, has become positive.

This positive potential on the front surface of A, at this point, induces negative potential on its corresponding back surface; positive on the front of B, and negative on the back and on the inductor X. In the same way, but in reverse order, similar conditions occur on the opposite side.

It will thus be seen, that while the brushes F and E act as generators, the brushes V and H act as dischargers; and while the combs K and L create a difference of potential in the jars, the combs V and H, like their brushes, discharge, and restore equilibrium.

When the difference of potential between the inner coatings of the jars becomes sufficient to overcome the resistance of the air, a discharge from the inner coating of D to that of C, takes place through the sliding electrodes R and P; and, at the same instant, a discharge from the outer coatings takes place through the switch and connections, from C to D, to restore equilibrium between them, and thus complete the circuit.

A spark and snap, from the resistance of the air, accompanies the discharge between the inner coatings; and the same will occur between the outer coatings if the switch is open; but, if closed, the discharge takes place silently. The plates and other parts being, at the same instant, relieved of strain, there is a restoration of equilibrium in the whole machine.

The above explanation applies to the machine when it is put in operation from a state of absolute rest; but when it is in a high state of activity, there frequently occurs a reversal of potential after a discharge, as shown by the reversal of the brushes of light from the combs. To account for this it must be considered, that after the primary discharge, a residual still remains; this, from unequal resistance, may be greater on one side than the other, and after being relieved from strain by the primary discharge, will operate to give a slight preponderance of potential to that side, which is rapidly multiplied by induction, as the rotation of the plate continues.

A reversal can also be produced by touching the inductors, or parts connected with them, while in action, which would reduce the potential at that point. Special conditions may also exist in certain machines, which will reverse the ordinary mode of action; as, for instance, a difference of thickness on opposite sides of a glass plate; or in opposite jars.

The condition of the air, as to its insulation, influences the whole operation of this machine. An air space insulates the plates, and also the jars, with their rods and balls, from each other; and as a damp atmosphere lessens this insulation, it will decrease the energy of the machine in like proportion. A film of moisture, settling on the plates, will often so reduce the insulation, that the slight initial charge by the action of the brushes is conducted over the damp surface as fast as it is generated; so that no difference of potential, and consequently no charge, can occur. And as the machine is much more sensitive to such influences than the operator, the latter is often puzzled to know why it will not generate. The simple and effectual remedy, in all such cases, is to dry it. This may be done by a fire, a kerosene lamp, a hot iron, or by the sun's heat, though artificial heat is generally more effectual.

Bright, warm, sunny days, before or after rain, when the atmosphere is loaded with moisture, are the most unfavorable. At such times the plates should not only be dried, but warmed, as moisture will continue to be deposited so long as they are colder than the air.

From this it is easy to see why a Holtz machine is so much more liable to stoppage than a Töpler; as the Holtz receives only a small initial charge, which is then discontinued, while that of the Töpler is constant, from the continuous action of the carriers and brushes: so that a well constructed Töpler is perfectly reliable in any kind of weather.

The views here given are not mere theory, or hasty deductions from imperfect data. They are the result of constant, daily experiment and observation, for several years, with both Holtz and Töpler machines, of almost every conceivable style, size, and variety, including a large number of the very best machines in use.

UNDERGROUND TELEGRAPHY.

AFTER all the agitation about underground telegraph lines, it appears that only one of nearly a dozen companies that have obtained permission to lay conduits has yet made any bona-fide efforts to carry out its undertaking. The conduit laid under Market Street a year or two ago is not included, for that proved no more than a stock jobbing enterprise, and when the flimsiness of the organization was exposed it went to pieces and is not likely to be revived. There have been also one or two short private lines constructed, but with these the public is not concerned.

The only work mentioned in Superintendent Phillips' report to the councils, which gives any indication of genuine progress, is the line of underground telegraph wires now extending from Third and Chestnut Streets to the Kensington station, a distance of about two miles. These wires have been laid upon the Brooks' system, and are said to give satisfactory results. The company has authority to extend its lines through a number of streets, and if the experiment line now in use give promise of permanent success, it is likely that the most of the telegraph lines can be carried underground in this way. The same system should also be applicable to the telephone wires. Whether it will accommodate the electric light as well, is somewhat uncertain.

Very many schemes of electric conduits have been devised that looked well on paper, and promised well in operation on short circuits and for a short time, but broke down under the conditions imposed by actual use. Nothing but experience can overcome the many difficulties of this problem and those who know the most about it promise least. It must be evident, therefore, that very few of the many speculative organizations that have sprung up in the last year have any real basis upon which to demand either privileges or subscriptions, and while the councils cannot undertake to distinguish the scientific merits of rival inventions, it is important that they hold all the companies to such a strict compliance with the conditions imposed by ordinance, that the public may distinguish for itself between the genuine and the merely speculative.—*Philadelphia Times*, Sept. 21st.

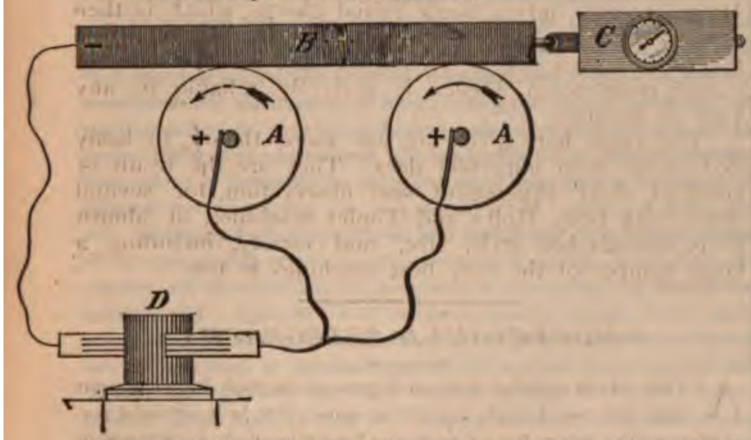
A RECENT DISCOVERY.

PROF. LEO DAFT, of Greenville, N. J., recently made a discovery, the knowledge of which may have a very broad influence upon a certain class of electrical work.

While making some experiments with an electrical railway, it was noticed that the traction of the electric locomotive, upon a grade of 2,000 feet to the mile, was far in excess of what was expected, on the basis of precedents furnished by steam locomotives. Subsequently, the influence of an electric current upon the traction was ascertained in the following manner:

A bar of iron, *B*, was placed upon two friction wheels, *A*, *A*, which revolved in the same direction. A spring balance, *C*, measured the pull due to the friction between the bar and the wheels.

When an electric current from a dynamo, *D*, was passed through the points of frictional contact, the pull on the spring balance increased twenty per cent. If further experiments confirm this statement of results, then it will prove that an electric locomotive will have a traction of twenty per cent. greater than a steam locomotive of equal size and weight; and, also, the advantage of using the rails instead of independent conductors.



It must be only a question of time before elevated railways are propelled by electro-motors; and while the elevated road might not be justified in abandoning their extensive locomotive plant in the event of a successful and economical system of electro-motors, yet such an invention would conduce to the introduction of elevated railways in other large cities, as by that means elevated railways would be robbed of much of their objectionable features of dust and noise.

A COMBINED TELEPHONIC AND BURGLAR SYSTEM.

MESSRS. Wm. Kline, of Toledo, Ohio, superintendent of the telegraph system of the Lake Shore and Michigan Southern Railway; W. S. Shoupe, of Elyria, Ohio, and Theodore Buskirk, of Toledo, Ohio, patented in Washington, June 13th, 1883, an invention called "The Combined Telephonic and Burglar System," which claims to provide the most adequate, certain, and cheap protector against burglars yet known. The system was first planned to make available for night use the telephone plant used in the day time for telephone purposes, but which lay idle and useless during the night. The system as perfected, however, can be used either in combination with the telephone, district telegraph system, or with a separate system of wires and exchange.

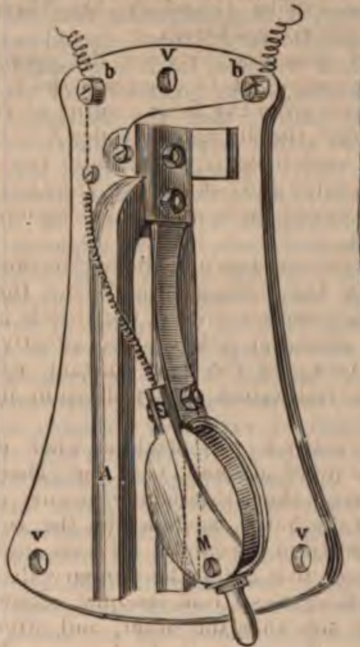
The invention consists of a local closed circuit, embracing the doors, windows, and all points of attack of the building sought to be protected, adapted to be thrown at will into or out of the main circuit, which contains the police station and exchange. During the day, the main circuit can be used for telephone or other purposes. When the building is closed for the night, the local circuit is switched into the main circuit, by means of an ingeniously devised switch, and if the local circuit is in working order, an automatic gong near the switch sounds. If the wire has been cut, or the local circuit is open anywhere, the gong will not sound. When the circuit is in working order, the breaking of the circuit by opening a door, or window, or the cutting of a wire in preparation for an attack, will sound the alarm at the central or exchange station, and also in the building of the subscriber, thus alarming the subscriber, and at the same time indicating at the exchange the point of attack, enabling them to telephone to the nearest police station, or to send them over watchmen.

When used in connection with the telephone exchange, the inventors have provided an auxiliary tag and attachments, to be attached to the ordinary drop tag of the exchange, and working with it, which, when the local alarm circuit is not switched in, falls with the primary tag, but when the alarm circuit is switched in, remains in position while the primary tag falls down, and remains down as long as the alarm circuit is switched in. When the local alarm circuit is broken, the auxiliary tag falls and strikes an annunciator, which rings an alarm bell in the central station, until the tag is replaced. This system will do away with the necessity of night watchmen in stores, buildings, or manufactories, and is far more certain and reliable, as it cannot be bound or bribed.

The New York system of safe protection can be used with this alarm, as also the Day fire alarm button, by simply changing them from an open to a closed circuit.—*Toledo Bee.*

SUPPRESSION OF BATTERIES FOR ELECTRIC CALLS.

SEVERAL attempts had been made in France to do away with batteries for electric alarms; but the special machines known as magnetic calls in other countries, were not used. They have a peculiar arrangement of the electric machine, and are worked by a crank. The recent invention of M. Abdank Abdakanowitcz, is very simple, and requires no care or expense. It consists of a permanent horse-shoe magnet, *A*, placed vertically, and fixed to a bearer which is attached at *V*, by means of a screw. A small flat coil, *M*, having great resistance, oscillates between its arms; this plate is suspended from a spring and placed at the terminals, *b*; in the circuit of the bellwork. By removing this plate from the vertical, and leaving it to the action of the spring, a series of oscillations of the coil is produced between the arms of the magnet; induction currents, which may be of considerable strength and overcome great resistance, are then produced.



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THE DECISION ON THE GRAMME PATENT.

THERE will be a general feeling of disappointment, in electrical circles, that the decision of Judge Blatchford, in the case of the Gramme company against the Arnoux and Hochhausen company, for infringement of the Gramme patent No. 120,057, could not have been on the merits of the invention, and the claims of the great French inventor to absolute priority in the discovery of the commercially efficient modern dynamo and motor.

When we consider how great is the contribution to science, what vast and varied results have already grown out of that invention, and what greater ones are in plain sight in the immediate future, it is unfortunate that the pretentions of the Italian savant, Doctor Pacinotti, should not have been set at rest by judicial decision, for it is probable that no similar occasion will arise. The great value of the invention has developed so slowly, that the European patents granted Gramme, will either expire by limitation within two years, or, being secret limited privileges, have been permitted to expire already, while the English patent not being accompanied by drawings, which were lost in transit during the German siege of Paris, in 1871, might not be sustained. Therefore, interest was centred upon the United States patent, which being limited in life, under Section 4,887 of the Revised Statutes, to the life of the prior French patent, had nevertheless the prospect of a "short life and a merry one," because it had become the property of a rich, powerful, enterprising, and prosperous combination, to whom it would be extremely valuable, in consequence of its sweeping control of the manufacture of dynamo machines, the one indispensable pre-requisite to any electric light or power business whatever. There has never been any serious attempt to infringe Gramme's patents, or to deprive him of the credit of his invention in France, and under the admirable management of M. Fontaine, the administrator of his affairs, the genial and accomplished inventor has become rich in money and in honors, and not at all disposed to guard his interests aggressively, or with jealousy. Eminent counsel were employed by both contestants, and a great amount of evidence was collected, and testimony taken, both here and in Europe. Judge Blatchford was supposed to be exceptionally equipped to determine so interesting a question; and, quite apart from any pecuniary concern in the decision, or any material results involved, although they were very great, a general interest and wide curiosity existed.

There was, therefore, some surprise, and much disappointment, that the decision should have been given upon a single point, not relating to the scientific or mechanical questions involved.

It had been generally understood, and was in fact set out by the complainant company, that a prior patent taken out in Austria, for the same invention, and by the same inventor, had expired in 1880, and it followed as a matter of course, that if the Austrian patent was such as was contemplated by Congress in the restrictive clause of Section 4,887, the United States patent must expire with it.

It was, however, held by the complainant company, that the Austrian patent of Dec. 30th, 1870, being a "secret" privilege, and never, if at all, becoming a "patent," until after the issue of the United States patent, Oct. 17th, 1871, could not by its termination, or lapse, affect the term of 120,057. It was, therefore, expected that a decision would be had upon the merits of the case.

Judge Blatchford's decision, however, after reciting what was substantially agreed upon by both complainant and defendant, concerning the expiration of the Austrian patent, and its effect upon the United States patent, assuming that the Austrian *was* a patent within the meaning of the law of the United States, says:

> "It is also contended for the plaintiff, that the Austrian patent was a secret patent, and, therefore, not a patent within the meaning of Section 25 of the Act of 1870. The Austrian statute provides, that the petition for a patent must contain a statement whether the invention is to be kept secret or not; that special care is to be taken for the observation of the required secrecy, and due precautions are to be adopted against any possible violation of the secret; and that specifications as to which secrecy is demanded, are not open to the public, or for the taking of copies, until the patent is extinct. In the present case, the petition for the Austrian patent stated that it was desired that the description be kept secret. *But the Austrian statute also provides that an exclusive privilege secures to the patentee the exclusive use of his invention, as laid down in his specifications, for the number of years mentioned in his privilege.* The Austrian patent in the present case, states, on its face, that it is an exclusive patent for the duration of one year, for the improvements in question, '*in consonance with the description deposited under all conditions, and with all effects stated in the Austrian statute.*' In view of these facts, however far the Austrian patent might have come short of being a prior public foreign patent sufficient to defeat a patent granted here to another inventor, for an invention made after the granting of such prior foreign patent, it is not perceived how the question of secrecy or publicity in the foreign patent granted prior to the granting of the patent here, can affect, under Section 25 of the Act of 1870, the question of the duration of the patent here. The Austrian patent conferred on the patentees an exclusive privilege. It was the manifest intention of Section 25 of the Act of 1870, that the exclusive privilege under the patent here should expire with the exclusive privilege granted abroad to the same inventor, having the shortest term."

Therefore the bill was dismissed.

But, it appears clear enough, that in order to determine what the word "exclusive" means, in the translated text of the Austrian patent, we must refer to the Austrian statute, and it is not doubtful that the significance of the word exclusive varies, according as a patent is a "patent" or a secret privilege. The most vital and important difference is, that in the sense of "exclusive," as applied to an American patent, Gramme had no "exclusive privilege" in Austria at any time, in other words, *there was never a day, since Dec. 30, 1870, the date of his Austrian patent, when any subject of Austria had not as much right as he had, to make and use his invention.*

The Austrian law must control the meaning of the words of a grant made by virtue of that law, and if every subject of the Kaiser-King had the same right that Gramme had to make and use his invention, the word "exclusive" in the grant must have a meaning which would not be welcome to the American inventor.

What Gramme acquired by virtue of his Austrian privilege, was, the *right to convert it into a patent, by taking proper legal measures*, and this right he never exercised.

He could "*demand a discontinuance*" of infringement, but only "*the repetition of an infringement prohibited before*" *is illegal*, and this is true to the end of the term. *An infringer may have been manufacturing and selling for fourteen years, before being discovered, and even then, can only be enjoined from continuing during the last year of a term, having enjoyed, free of charge, or damage, the same rights that the patentee* had in his invention, for nearly its life.

It is supposed that the Gramme company will appeal to the Supreme Court, thus continuing an element of uncertainty in the general business, outside the limits of that combination, and if that court sustains the appeal, we shall at last, after a delay vexatious, injurious and expensive to all concerned, reach a conclusion upon the merits of the controversy.

ELECTRO-MOTORS.

THE late Fleming Jenkin stated, shortly before his death, that the reversibility of the Gramme ring was the great mechanical invention of modern times. The laws of the mechanical theory of heat had long ago showed the work of the steam engine to be merely the conversion of the unwasted portion of the heat of the steam into work, and that the steam obtained this capacity for work from the chemical action of the burning fuel and the air under the boilers.

Thence the gases which are belched forth from the hot furnaces are seized upon by nature, and, by the aid of the sun's alchemy, transmuted into vegetation, awaiting the demands of man to be used again as fuel.

With the water wheel, the water falling from mill pond to trench and turning the wheels, is ultimately evaporated by the sun and transported back to higher levels.

Each step of these instances is easily susceptible of proof and measurement; but no one ever constructed a steam engine which converted its work into heat by friction, generating steam, and ultimately operating a second engine.

In the dynamo machine the cycle of changes, illustrating the conversion of work into different forms of energy and back to work, is a matter of frequent occurrence, and susceptible of proof wherever there are two dynamo machines, one of which is provided with means for its operation.

The work of the power in the belt applied to one dynamo generates an electric current, and this electricity conducted to the other dynamo produces work. If the effort of reproducing work were tried with the steam engine, the losses would be so great that the experimenter would probably succeed in converting only about three per cent. of the power of the first engine into work at the second engine. In the dynamo, the matter at issue is on a far different basis; instead of a meagre three per cent., experimenters have reconverted over eighty per cent. of the power applied to the first dynamo, as power exerted by the second dynamo.

There is nothing new about this, as these principles have been common knowledge for years; and it is a matter of surprise that they have never been used in a commercial manner, when, at the same time, there is an admitted promise of a demand, whenever responsible parties are prepared, to supply the market.

For several years we have read the promises of electro-motors in the circulars of the electric light companies; while about half of the illuminating companies have been incorporated as Electric Light *and Power* Companies, and we doubt whether one of them ever exercised the right to sell power furnished by electro-motors.

We recall but two instances where an electro-motor is in practical use; one is a sewing cotton mill in Newark, where a fine eight-light Weston dynamo furnishes the current to a smaller dynamo, which serves as a motor, and drives a number of spool winding machines in a room over a storehouse, where it would be expensive and inconvenient to conduct a line of shafting, The other instance is in a cotton mill in Newburgh. where a Daft dynamo in the mill furnishes the electricity for a reversed dynamo machine, which serves as a motor, and operates the elevator in the cotton storehouse, some six hundred feet distant, where three bales of cotton can be raised or lowered on the elevator at the same time. This same dynamo is also used on two lighting circuits, one of three arc lamps, and the other ninety incandescent lamps.

A few years ago, Sir William Thomson presented a plan to distribute a portion of the energy of the falling water at Niagara Falls around the State. Turbines, dynamos, conductors and motors were outlined on a gigantic plan. There have been numerous schemes of transferring the power of wind, waterfall and tide to some distant town; generally the storage battery is drawn into the plan as a convenient go-between.

A short time ago the treasurer of a large mill, in Maine, wished to avail himself of the use of a water power situated on the same stream, some distance above the mills. The problem of transmitting 150 horse-power a distance of three and a half miles, was submitted to the representatives of several electric companies. All declared that they could do it, but no one was ready to sign a business-like contract with provisions of the usual character for failure or delay, and, as a consequence, a steam engine and boilers have been put in to operate the increased machinery in these mills.

That tricycles, yachts, miniature railways, and other toys have been operated by electro-motors, does not pertain to the object of this article. We ought to have an extensive use of electro-motors in our large cities, corresponding to the general use of gas engines in England, for small powers.

In the same buildings, our cities contain stores on the first floor, which use electric lights at night, but during the day the artisans in the upper stories use many small steam engines. The cost of maintaining a small steam engine is far in excess of the proportionate cost for a large steam plant. The small engine not merely uses a relatively larger amount of fuel, but the expenses of supplies, attendance, floor space, and repairs are so much in favor of a large plant that the actual cost of a horse-power in a large engine, under favorable conditions, is one-quarter that of a small engine, as generally run.

There is no question upon the room for profit in such distribution of power where tenants are numerous and their business constant, even if there were a loss of fifty per cent. between the driving engine and electro-motor. But we have omitted all reference to one great difficulty in the matter of electro-motors, and that is, the absence of an adequate governor. It is indeed true, that some of the motors have brakes and rheostats, but such wastes of energy are not worthy of the name of governors. There must be some form of governor which will preserve a constant velocity to the armature of the motor, when the mechanical resistance is variable, within the limits of practical use.

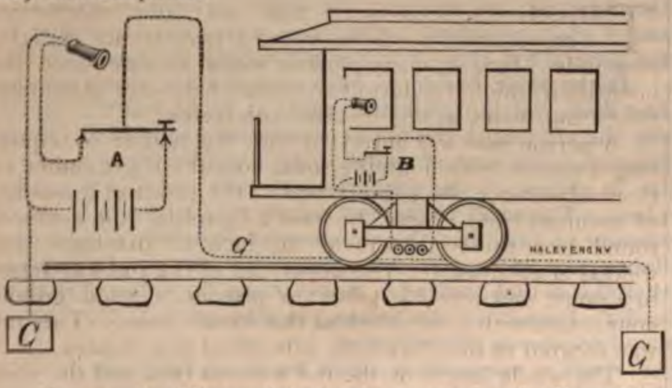
—— A CABMAN in Vienna is said to use electric lamps on his cab, and in one announcement it is stated, that he obtains the current from a dynamo mounted on or driven by the axle.

RAILROAD TELEGRAPHING.

A system of inter-communication between fixed stations and moving railroad cars has been recently explained to us by the inventor, Mr. Lucius J. Phelps, an electrician of this city. The invention is certainly very simple, and apparently very practical, and, as a company will soon be organized for its introduction, we may expect soon to see every railroad train a traveling telegraph station.

The sensitiveness of the telephone and the difficulty that is experienced on all telephone lines from induced currents, is the foundation of the invention, and an apparatus is constructed simply for the purpose of augmenting this induction and making it useful in transmitting signals; thus doing away entirely with all electric contact between the line conductor and the car, which has been the almost insurmountable obstacle in the way of all other similar attempts. The recent improvements in dynamos also, whereby powerful and reliable currents are obtained at small expense, is an almost indispensable factor in the introduction of this system.

By referring to the accompanying cut, a clear understanding may be had of the system in its most simple form. A line conductor, *C*, is laid along the centre of the track, held in its place and insulated either by means of insulators made expressly for that purpose, and fastened to the ties at short intervals, or by using insulated wire, and protecting it from damage by a wooden box or cover. Underneath the car, and about three inches above this line conductor, are placed a series of large coils, each consisting of an iron core wound with coarse insulated copper wire, the cores of these coils being at right angles to the line conductor, The terminals of this series of coils are taken up into the car and connected to a telephone through the back contact of an ordinary double-pointed Morse key. The front contact of the same key is connected also through the coils and through a small local battery, as will be readily understood by tracing the dotted lines at *B*. The terminal station, *A*, is arranged in a similar manner, with battery, double-pointed key and telephone.



If, now, the Morse alphabet be sent over the line *C* by the key at *A*, it can be distinctly read in the telephone at *B*. If, also, the Morse alphabet be sent through the coils and local battery at *B*, it can be distinctly read in the telephone at *A*. In order that signals received at *B* may be sufficiently loud to be heard in spite of the noise of the train, it is necessary to have a current of about two ampéres sent over the line *C*. But as the terminal station *A* may always be in a quiet office, a less volume of sound is necessary, consequently a very small battery, as two Leclanché cells is sufficient on the car.

The above simple system, although it may be considered as complete in itself, and may be used successfully, even if no further developments were possible, still it is lacking in some very desirable features. For instance, no communication can be had between one train and another directly. Confusion might, therefore, arise if more than one train should attempt to communicate with the terminal station at the same time. It is also inefficient, in that the operator at either end cannot be signaled unless he has his ear constantly at the telephone.

The inventor has anticipated and successfully overcome these objections in the following manner:

For an electric generator at the terminal station he uses a dynamo machine, with commutators so arranged that by simply moving a switch on his table he changes the electric current from a continuous current to an alternating current and vice versa. The alternating current is still governed by his key the same as before, and the instant an alternating current is sent over the line, an alternating current is induced in the coils at *B*, sufficiently strong to ring a signaling bell, or work an ordinary Morse sounder, if desired. But it has been found, after numerous experiments, that a telephone is the best possible receiving instrument on the train, as when it is held closely against the ear it shuts out the noise of the train, and can be easily heard in places where it would be almost impossible to hear an ordinary sounder.

For the transmission from the car to the station, an alternating current is used exclusively, either generated by a small dynamo located on the engine, or by an ordinary chemical battery with a current shifting device situated in the circuit, run by clock work, and so arranged that it will change the polarity of the current from 500 to 1000 times a minute. This clock work is normally held by a brake, a spring that the operator touches with his foot releases the brake, and it is then ready for action.

This rapidly shifting polarity of the current, and the corresponding shifting of the magnetic polarity of the iron cores, induces in the line conductor an alternating current, which will energize a delicate relay at the terminal station. The key at *B*, governs directly the primary current through the coils, and indirectly the secondary or induced current over the line, and it will readily be seen, that signals given by the key at *B*, will be recorded by the relay at the terminal station *A*.

The principal object, however, of using a relay at the terminal station is not so much because a relay and sounder is any better than a telephone as a receiving instrument, but the relay is made to act as a repeater, to repeat each signal automatically over the line again, in order that it may be received by every train on the route.

The bobbins of the relay are wound with double wires. The contact points close the circuit from the main dynamo over the line. Outgoing currents pass through the coils in both directions, having no effect upon the magnets, while incoming currents pass through the coils only in one direction and energize them. The arrangement is exactly like the ordinary Siemens' duplex instrument, except that the relay governs the outgoing current instead of its being governed by an independent key.

The inventor also claims, under another system, the use of the Rhumkorff coil, governing the primary circuit by a Morse key, and arranging the secondary circuit so that sparks are sent from the car to the line, and from the line to the car, using, as before, a telephone as a receiving instrument.

He also claims the use of a magnetic needle on the car, near to the line conductor. To overcome the effect of terrestrial magnetism, he arranges two needles on a vertical shaft with their corresponding poles turned in opposite directions. Deflections of the needle are determined by the direction of the current, and a local circuit is closed or opened at the will of the operator at the terminal station, by shifting the polarity of the line current.

ELECTRICAL EXHIBITION OF THE FRANKLIN INSTITUTE.

THE Electrical Exhibition in Philadelphia, was decided upon by the board of managers of the Franklin Institute, a year ago, and would have been held during the present Autumn, had not the announcement of an International Electrical Exhibition in Vienna interfered with the managers' plans.

The managers of this institute, the oldest mechanics' institute in the United States, and the originators of the now so popular system of exhibitions of arts and manufactures, fully impressed with the belief, that the time has arrived, when, by reason of the magnitude and diversity of our industries, general exhibitions of manufactures should be relegated to the great world's fairs, and that special exhibitions, representative of the progress of some important branch of the applied sciences could be made more valuable and instructive, decided, after much consideration, to select the subject of electricity and its applications, as the most promising with which to introduce this departure from their time honored custom.

The cordial relations which for many years have existed between the institute and numerous scientific bodies in Europe, suggested the idea to make the proposed exhibition international in its scope; since it was believed that the institute could undoubtedly depend upon the usual support and encouragement of many such learned bodies, in furtherance of its project, to make the proposed exhibition representative of the present state of advancement of this fascinating branch of science. In furtherance of this view, the draft of a bill was passed, admitting all articles from European countries intended for the exhibition, free of duty, and was unanimously passed by both Houses of Congress, and signed by the President. The bill in question is an almost liberal copy of the bill passed in behalf of the Centennial Exhibition in 1876, and is amply general in its provisions to relieve European exhibitors of all difficulties relating to the entry of goods.

Having arranged these necessary preliminaries, the managers proceeded to the task of raising a "guarantee fund," which should be sufficiently large to enable them to carry out their project on a fitting scale, without subjecting the institute to the risk of pecuniary loss. Fifty thousand dollars was fixed upon, as a reasonable amount, to give the managers the assurance that the institute was fully secured against possible loss, and in a few weeks the larger proportion of this sum was subscribed, and from present indications the fund will considerably exceed the amount named, long before the opening of the exhibition.

As there was no centrally located building in Philadelphia, large enough for the contemplated exhibition, it was necessary to select a suitable location upon which to erect a new building for the purpose. Of several sites offered, one a few squares beyond the Market Street bridge, in West Philadelphia, was considered the most eligible, and has been partly tendered to the institute by the Pennsylvania Railroad Company. The location comprises one entire block, and is accessible from all quarters by street cars and steam roads.

The first public announcement of the exhibition was then made, and has been distributed to all who may be presumed to be interested in the subject of electricity, both in the United States and Europe. The work of arranging the details will at once be taken in hand by committees composed of members of the institute, specially appointed for the purpose, and the erection of a suitable building will be commenced in the spring of the coming year.

It is the aim of the managers of the institute to make the forthcoming exhibition not merely a very attractive and brilliant show, but to render it memorable as an event of scientific importance; to this end, the most careful and exhaustive series of test of electrical apparatus will be elaborated, and fully announced in advance. The meeting of the American Association for the Advancement of Science, which will be held in Philadelphia, in 1884, about the time of the opening of the exhibition, will probably enable the managers to secure the active co-operation, in this scientific work, of many of the members of that distinguished body. Add to this the fact that the British Association will hold its next year's session in Montreal, and that a joint meeting of the two associations will probably be arranged, and it will be strange if the fortunate circumstances of the presence on the ground of the most distinguished representatives of American and British science will not be turned to good account.

The International Electrical Exhibition of 1884, therefore, promises to be in all respects a notable one.

THE next book on evolution ought to contain some reference to the means which Prof. Spencer Baird, of the Fish Commission, has prepared for fishing by means of an electric light, as being the evolution of the use of a pine torch by the Indians, to attract the salmon to their vision and the reach of their spear. The vessel of the commission is provided with incandescent lamps to lower into the sea, and while the fish are examining this phenomenon, a scoop net secures the pleasure of their company on board. Arc lights are also used for similarly illuminating the surface of the sea. Some one, encouraged by this use of the light in fishing, will soon make some marvelous proposition for an equipment of secondary battery and electric light helmet for jack shooting.

THERE has been much talk and little information respecting the efficiency and arrangements of lightning rods. Indeed, many persons would as soon have the invocation which the devout Canadian habitants place over their front doors, as any metallic conductors.

A person who was entrusted with the matter of equipping a church with lightning rods, consulted a number of electricians upon the subject, and as the result of a number of opinions from experts, he used a lightning rod made of round iron three-quarters of an inch in diameter, and welded at each joint. The upper end of the rod was drawn to a point, and care was taken to provide a good ground connection with damp earth at the lower point. The rod was secured to the church by galvanized iron staples.

The whole length of the rod was 192 feet, and the cost, $14.80, or seven and three-quarter cents per foot.

The rod conducted away a charge of electricity during a thunder storm, without any damage to the church.

—— THE OVERLAND TELEPHONE COMPANY are putting out telephones in all parts of the State. They hold the exclusive license for the entire State, and are appointing agents and disposing of territory to sub-companies that are being formed for the establishment of local exchanges. Their instruments are handsomely gotten up, and are superior in many respects to those in common use. Mr. E. W. Smith, who, until recently, was with the Bell Telephone Company, has accepted the position of Superintendent, and entered upon his duties at their office, 784 Broad Street.—*Newark Call.*

ELECTRIC LIGHT AT THE CINCINNATI EXPOSITION.

FOR some years past the managers of the Industrial Exposition, which is held annually at Cincinnati, have offered special premiums for excellence in some special class of machinery, and have taken great care to secure exhaustive scientific tests of the competing apparatus by experts of recognized ability and standing. These tests have been generally recognized as of great practical value, on account of the thoroughness and impartiality with which they have been conducted.

This year electric light apparatus has been selected as the subject for the tests, and special premiums have been offered, as follows: The best system of incandescent electric lighting, $500; the second best system of incandescent electric lighting, $300; the best system of arc electric lighting, $500; the second best system of arc electric lighting, $300; the best storage battery in operation, $100; the best system and apparatus for electric lighting, gold medal; the best system of electric lighting (arc and incandescent combined), gold medal; the best incandescent electric light (single lamp), gold medal; the best dynamo-electric machine, silver medal; the best electric engine for motive power (not less than one horse-power in operation), gold medal.

An expert jury has been appointed to make the tests, consisting of Prof. Mendenhall, of the University of Ohio, Prof. Eddy and Prof. French, of Cincinnati University, and Mr. Robert Laidlaw, Treasurer of the John H. McGowan Company, manufacturers of hydraulic machinery at Cincinnati.

Three electric light companies have entered their apparatus for competition. The United States company has submitted both its arc and incandescent systems and an electric motor; the Edison company its incandescent system, and the Thomson-Houston company its arc system. As it is a condition of competition for the awards that a certain number of lights shall be run during the exposition for lighting the building, an excellent opportunity is afforded for seeing the lights of the different competing systems in operation, under the most favorable conditions. Inadequacy and irregularity of power, which have proved so embarrassing to exhibitors of electric light apparatus in nearly all previous expositions of this kind, have been entirely avoided at the Cincinnati Exposition by the excellent arrangements which have been made by the managers. A large Cummer engine has been erected, especially for furnishing power to the electric light plants, and ample boiler capacity has been provided, so that serious variations of steam pressure are avoided. The Cummer engine appears to govern very closely, and has proved very satisfactory to the exhibitors.

As the tests are the principal feature of the exposition, so far as electric light is concerned, the companies exhibiting have, apparently, paid more attention to the quality of their lights than to making a large display. The Edison company is running between four and five hundred lights, which are arranged principally about the art galleries and in the ante-rooms and corridors on the second floor of the main building. Two 250 light dynamos are used, one driven from the main Cummer engine, and the other by a special Armington & Sims engine.

The United States company is running two hundred Maxim incandescent lights and twenty Weston arc lights. Most of the incandescent lights are placed in the main vestibule and about the grand staircase, and in the commissioner's offices. The arc lights are used for lighting the Horticultural Hall, the main entrance and one of the corridors. The dynamos used in both systems, as well as the primary machine and motor exhibited by this company, are of the Weston type, and are driven from the main engine.

The Thomson-Houston company is running twenty-five arc lights, distributed about the main floor and galleries of Machinery Hall. A twenty-five light dynamo is used, which is driven from the main engine.

The great excellence of all the lights is a very encouraging indication of the great progress which has been made during the past few years in perfecting electric light apparatus.

So far as general appearance and effect are concerned, there seems to be little room for choice between the Edison incandescent lights and the Maxim incandescent lights, or the Weston arc lights and the Thomson-Houston arc lights. The Edison lights appear, so far as can be judged by the eye, to be run somewhat below the sixteen-candle standard and the Maxim lights considerably above, and the Edison lamps are showing somewhat greater signs of discoloration than the Maxim. The effect of the porcelain shades used on the Thomson-Houston arc lamps is somewhat more agreeable than that of the ground glass shades used on the Weston lamps, but the color of the Weston light seems to be softer and more agreeable than that of the Thomson-Houston. Both are remarkably steady.

The awards, however, must evidently turn on questions of comparative efficiency, ease of management, and excellence of construction of the apparatus, which can be determined only by the tests. The jury have made elaborate preparations for the tests, and are, apparently, conducting them with great care and thoroughness. We await the publication of their report with much interest, as it cannot fail to prove of very great value.

It is to be regretted that the other electric light companies have not shown sufficient faith in the excellence of their apparatus, to submit it to such tests as these, but the three companies which have had the courage to enter, appear, from all that we can learn, to be doing a much greater amount of actual business than any of the others, and most of the questions in which the public has most direct practical interest will be determined by the decision of the conflicting claims of these competitors.

Some of the special premiums were evidently arranged with reference to securing tests of storage batteries, but they have failed in this purpose, as there are no entries.

Both the Brush and the Faure storage batteries are conspicuous by their absence. We strongly suspect that neither of the storage batteries now before the public, is yet sufficiently perfected to make it judicious to submit it to the criticism of unsympathetic experts.

— "GIVE IT A SHOCK." A young man from Chicago stood before one of the most elegant bars in Cleveland and gave the above order to a bartender, who stood waiting for a citizen to dispose of rather a big drink of pure whiskey. "A what, sah?" asked the chemist, leaning over the bar to catch the customer's remark. "Why, a shock. Haven't you imported an electric machine here yet! They're getting popular out West." The young man raised the glass to his lips and drank its contents at one draught. "It is nothing but a cheap method of purifying whiskey," said he; "age and purity are almost synonymous in speaking of liquor. By this process every saloon can have a little machine turned by hand, and every person can be personally convinced that his whiskey is electrically pure. All that is necessary is to have two blocks of carbon, which are inserted in the liquor to be purified. These carbons are connected with the positive and negative poles of an ordinary electric machine, and are wrapped about with flannel. The chemical action upon the liquor is such that all the impurities are attached thereto. The excess of fusil oil also finds lodgment in the flannel, and when the latter is removed, it looks as if it had been steeped in brine. Dealers will no longer need to use the antiquated prevarication that wine has been sent on a sea voyage. The necessary age can be attached to it by a dynamo-electric machine in a few minutes.—*Newark Sunday Call.*

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

V.—ENGINES CAPABLE OF DIRECT CONNECTION.

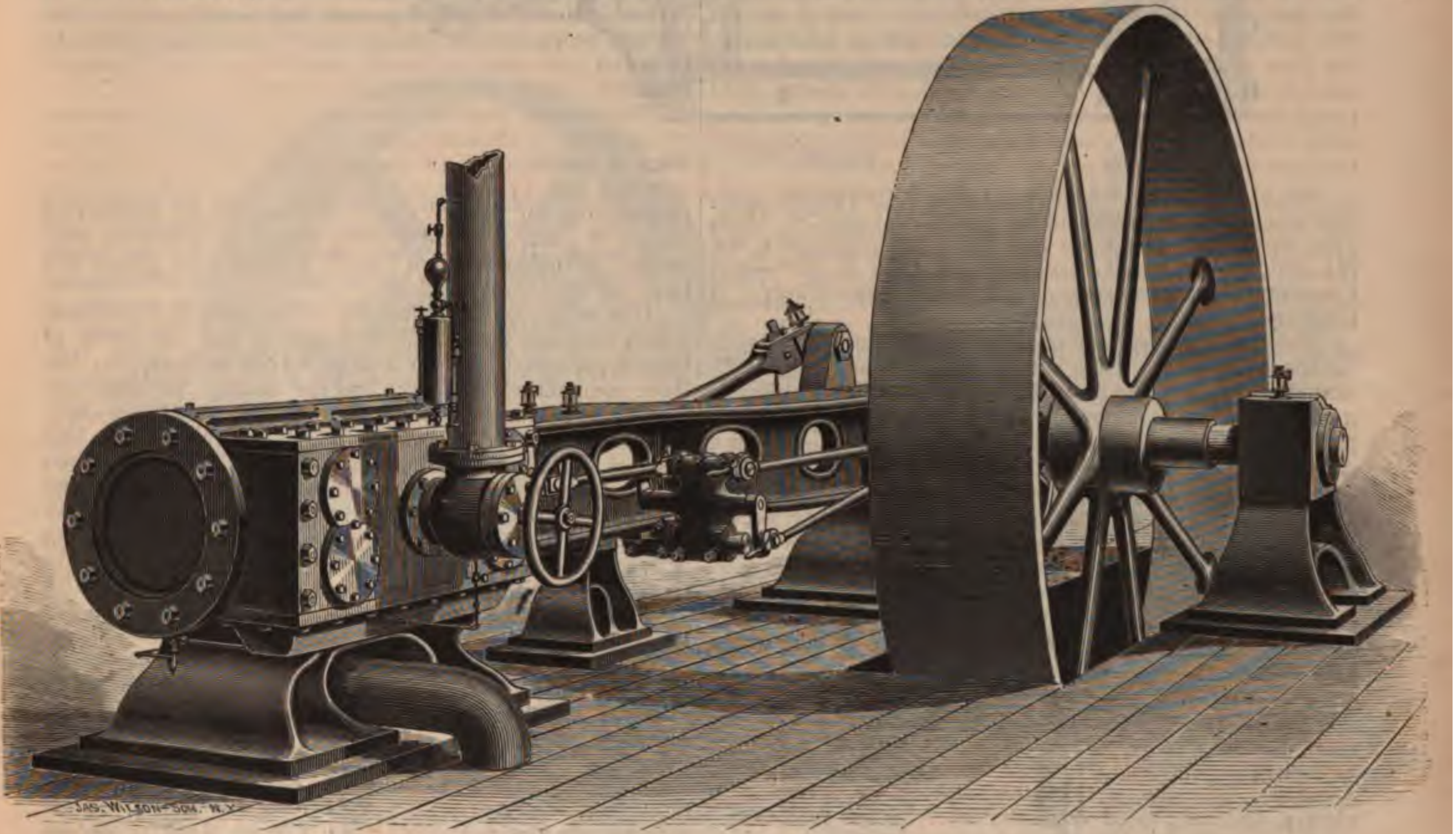
THE "BUCKEYE" AND "HARTFORD" ENGINES.

THE engine last described was a long time alone in the field as a "high-speed engine." The principle represented by its designers was recognized as correct by every intelligent engineer, and it was admitted that the fast engine, other things being equal, would prove the most economical in its expenditure of heat, as well as in its efficiency as a machine subject to friction. But builders were not able to bring themselves to accept what seemed to them the risks incident to high speeds. The pioneer in this new field was not altogether successful, for a time, and it seemed to be certain at one time, that the engine, despite the pluck, the persistence, and the skill of its indefatigable promoter, must retire from the market. But no discouragement could quite destroy confidence in this engine, which had become the embodiment of the most recent phase of progress. Gradually, one difficulty after another was overcome; parts were strengthened and given satisfactory proportions; the materials were improved and the workmanship of the machine was made as nearly perfect as the best tools, handled by the best workmen, could make it. A little gain was seen each year, and, after a time, it was seen that the new class of steam engine had "come to stay."

One of the first engines to come into the field after this period of doubt had closed was built by an enterprising firm of Western manufacturers. This was the "BUCKEYE ENGINE," designed by Mr. J. W. Thompson, and built by the Buckeye Engine Co., at Salem, Ohio. The engine did not start as a radical competitor of the pioneer engine; but it was, from the beginning, a moderately high-speed engine. It was fitted with a positive motion "automatic" valve-gear and a balanced valve, and had a stability and an excellence of workmanship that made it safe at fast speeds; while the peculiarities of its construction were such as gave it a very high place as an economical machine. It was capable of meeting in competition the best engines of the day.

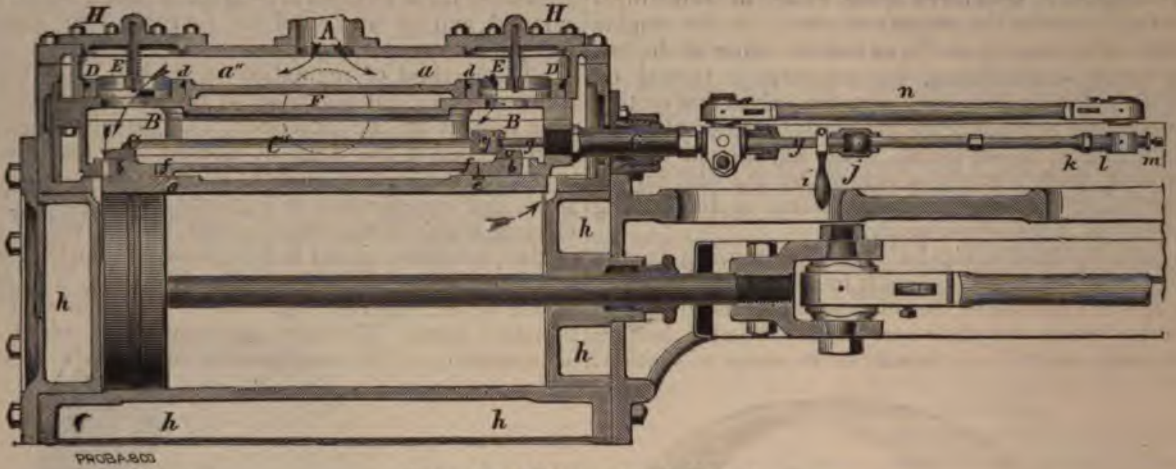
The form given the larger sizes of this engine is seen in the accompanying Fig. The general arrangement is not essentially different from that of the Corliss engine, which has been described in earlier articles.

The cylinder is carried on a pedestal, as is the latter; the frame consists of a girder uniting the cylinder and the main pillow block and carrying the guides; the crank-shaft end is carried by another pillow block. The main frame is, however, supported by a strut which is not usually seen in other engines, and which takes the load tending to spring the girder under the guides. The construction of the cylinder, and the arrangement of the valves, is shown in the next Fig.


JAS. WILSON—SON. N.Y.

BUCKEYE AUTOMATIC ENGINE.

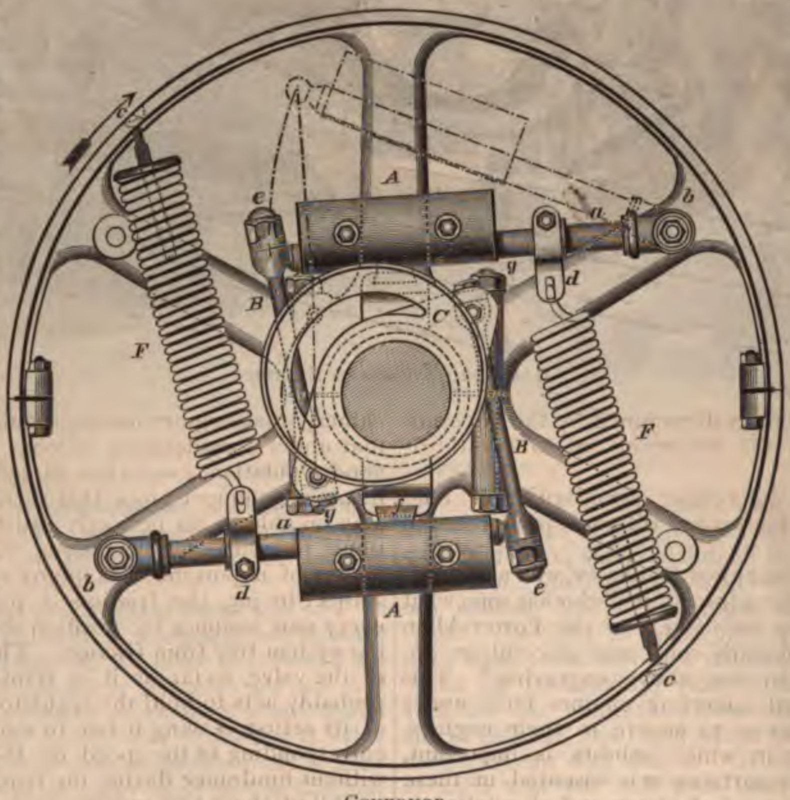
The live steam is taken into the steam-chest at *A*, passes through the passage, *a*, *a*, through the openings, *D*, *D*, into the box-shaped valve, *B*, *B*, and thence through the ports, *b*, *b*, into the cylinder, as the ports in the cylinder are alternately brought opposite those in the valve. The cut-off valve is formed of two sliding plates, *C*, *c*, connected by rods, *C'*, and sliding on seats formed on the inner, or working, side of the main valve, so as to cover the main steam ports alternately, and at times which are determinable by the governor. The stem, *g*, driving this valve, passes through the main valve stem, which is made hollow for that purpose. The cut shows the steam entering the cylinder at the left, and the cut-off valve just beginning to slide over the port, while the exhaust is taking place at the right, *past* *the end of the main valve*, through the chest, and around to the exhaust pipe seen partly dotted at *F*. At *e*, *e*, are seen two "relief chambers," which receive live steam from the steam valve through holes, *f*, *f*, and thus balance the valve at a time when the pressure on the seat caused by the then excessive area of the balance openings, *D*, *d* (which openings must be made sufficient in area to produce a slight pressure of the valve on its seat when the tendency to lift the valve from its seat is greatest), is overbalanced. These holes only fill when this relief is needed. The equilibrium rings, *D*, *d*, seal the joint between the valve and the diaphragm separating the steam-chest, *a*, *a*, from the exhaust-chest *F*.



SECTION OF CYLINDER AND VALVES.

The governor is of a type that has not been seen in the engines previously described. It is shown in the following illustration.

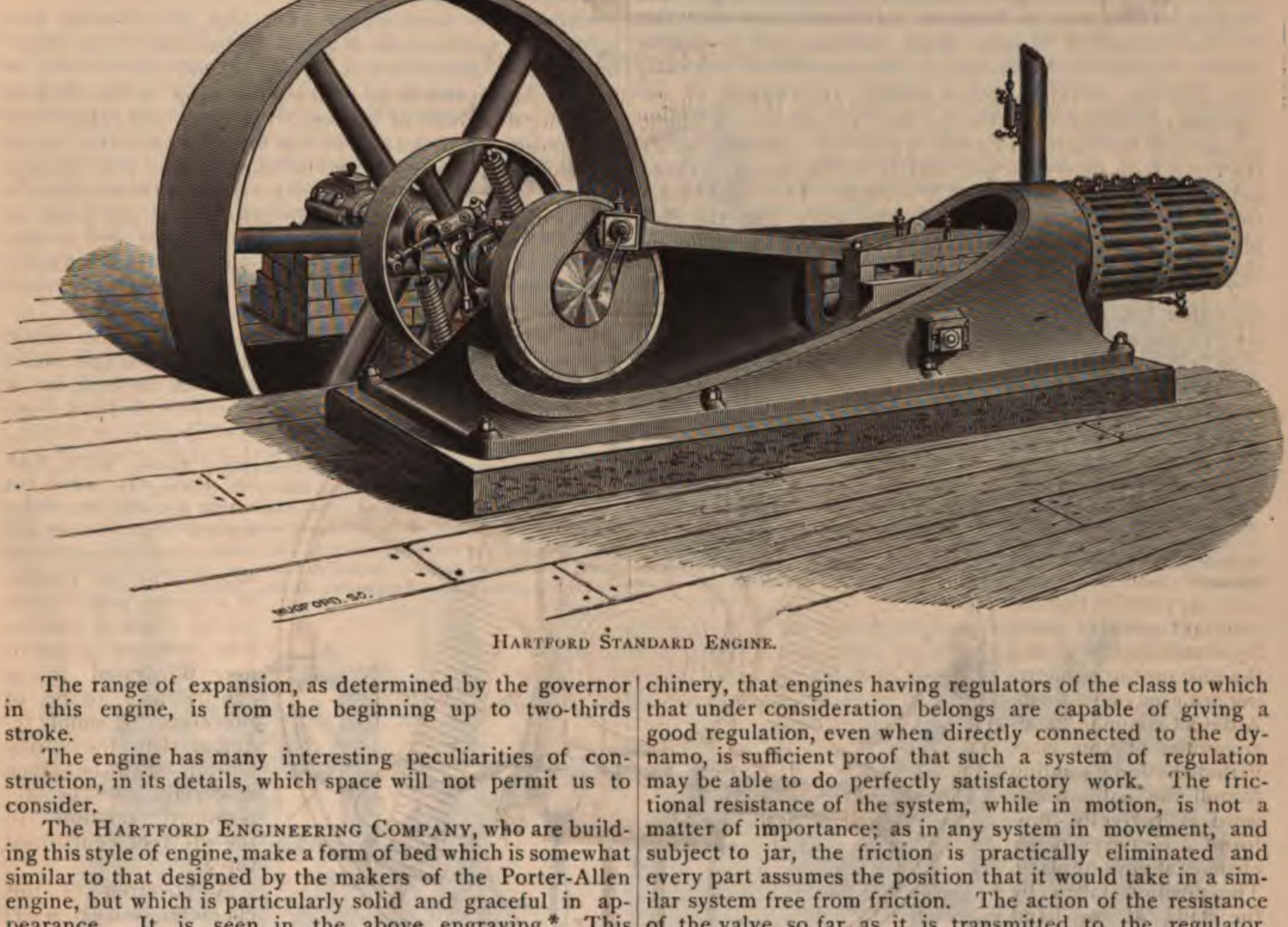
In the common "fly-ball governor," the two balls revolve about a vertical spindle, to which they are attached by a pair of arms in such a manner that they may take any position that the resultant action of gravity, centrifugal force, and the pull on the supporting arms may give them. A defect common to all governors of this class is that the force tending to pull the balls downward is perfectly uniform. Gravity never changes at any one place. The position taken by the balls, at any fixed speed of engine, is always the same; the connection of the balls with the regulating mechanism, is one which always preserves a fixed relation between the position of the governor balls and the position of the regulating apparatus. Thus it happens that the engine can never be kept precisely at speed, unless the speed is such as will give the governor exactly its normal position and, at the same time, such that the valves shall supply just the normal quantity of steam to the engine. With reduced steam pressure, the engine drops to a slightly lower speed, and runs at that speed instead of the proper number of revolutions; when the load decreases, the engine runs at a little higher speed than is intended; and no method of attaching that form of governor can give absolutely uniform speed. If, however, we can substitute for the action of gravity, a force which can be made to vary with change in the position of the balls, in such a way that the variation in the opening of the throttle, or in position of the point of cut-off, shall go on until the engine comes to speed, irrespective of all other conditions, we shall have what is known as an "isochronal" governor, and shall be able to get the correct speed, whatever changes occur in steam pressure or in load, provided that there is steam enough to drive the load at speed with the least expansion for which the engine is designed. Such an adjustment can be made by substituting the tension of a spring, properly set for the action of gravity. The form of governor here illustrated is, or can be made to be, of this class. It simply requires that the spring tension shall be given a certain easily determined relation to the effort of centrifugal force.



GOVERNOR.

A governor of this character, when well made and adjusted, will open the throttle valve, or will increase the ratio of expansion, as the steam pressure diminishes or as the load is increased, and will continue to move in the proper direction, indefinitely, or until the machine comes to speed, or until the engine is doing all that it can do. In the governor here used, two levers are set on either side the crank-shaft, in a frame or a pulley to which they are pivoted at *b*, *b*. These rods carry weights, *A*, *A*, which may be adjusted to any desired position by means of the bolts seen in the cut. The outer end of each rod is linked to the loose eccentric, *C*, *C*, by the rods, *B*, *B*, and is controlled by the springs, *F*, *F*, which resist the effort of centrifugal force tending to throw the weights outward. As the weights swing outward or inward, as the one or the other of the two opposing forces predominates, the eccentric is turned on the shaft in such a manner as to give the valves that motion which is necessary to produce the proper distribution of steam to bring the engine to its speed. The adjustment of this regulator to its work is easily obtained by the shifting of the weights along the levers, or by increasing or diminishing their amount, as is found necessary.

This governor is adjusted for an engine moving in the direction of the arrow. To adapt it to an opposite motion, the pins, *b*, *b*, are shifted to the other set of arms which are shown having bosses for their reception. Wooden buffers check the governor at the extremity of its range of motion.



HARTFORD STANDARD ENGINE.

The range of expansion, as determined by the governor in this engine, is from the beginning up to two-thirds stroke.

The engine has many interesting peculiarities of construction, in its details, which space will not permit us to consider.

The HARTFORD ENGINEERING COMPANY, who are building this style of engine, make a form of bed which is somewhat similar to that designed by the makers of the Porter-Allen engine, but which is particularly solid and graceful in appearance. It is seen in the above engraving.* This firm, as well as the original makers of engines built under Thompson's patents, endeavor to secure in their engines, great weight in the parts in which solidity is important, such large area of bearing surfaces as is essential in these engines, moderately high-speed of piston and of rotation, a steam pressure, usually, of about 80 pounds per square inch, and adopt a ratio of expansion for their non-condensing engines, of from four to five. Their table of powers of their standard sizes is based upon estimates for steam at 80 pounds and a cut-off at one-fourth. In construction, these engines are carefully made with all joints scraped, and all pins, and all journals also, ground with scrupulous care.

The method of regulation is, as has been seen, quite different from that practiced by the older standard makers. It is subject to the objection, that as the regulator has thrown upon it the duty of altering the position of the eccentric, the load so brought upon it may make it less sensitive and less effective in regulating the speed. This conclusion, which is that usually held by the older engineers in the profession, seems to be contrary to the fact; although, when comparing the older kinds of engines, it is fully sustained by the superior regulation of the engines of the "automatic" class. The fact, now familiar to every engineer accustomed to the management of electric lighting machinery, that engines having regulators of the class to which that under consideration belongs are capable of giving a good regulation, even when directly connected to the dynamo, is sufficient proof that such a system of regulation may be able to do perfectly satisfactory work. The frictional resistance of the system, while in motion, is not a matter of importance; as in any system in movement, and subject to jar, the friction is practically eliminated and every part assumes the position that it would take in a similar system free from friction. The action of the resistance of the valve, so far as it is transmitted to the regulator, probably acts to hold the regulator fast during the period of its action, leaving it free to move into any new position, corresponding to the speed of the engine at the instant, without hindrance during the remainder of the time.

All of these fast-running engines will be seen to have shorter strokes of piston than is customary with the earlier types. One reason which has guided their designers to this proportion is that the loss by internal condensation becomes less as the steam is given less time to discharge its heat, and hence high-speed of rotation and short strokes are adopted. The best proportion of stroke to diameter of piston, the number of revolutions in the unit of time being fixed, is easily ascertained by a very simple investigation. It is found to be two to one. This is about the proportion generally adopted in these engines. Many engines are, however, given a ratio of 1 1-2 to 1. The shorter stroke has the great additional advantage, the speed of piston being the same, of giving a less costly engine to build. The proportion is sometimes dictated partly by the character of the work to be done; thus, in driving the dynamo directly, the velocity of rotation must be very great and a short stroke becomes advisable—the shorter as the speed is higher. In such cases, therefore, engines are often made with even shorter strokes than considerations of "efficiency" alone, would dictate.

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* The first designer to carry the line of this steam cylinder along the surface of a "box-bed," and thus to secure maximum vertical and horizontal stiffness in this manner, so far as the knowledge of the writer extends, was Dr. E. D. Leavitt, Jr., who made such an arrangement in engines, in the design of which the writer assisted, as early as 1859 or 1860.

Reviewing the construction of this engine, it is seen that it is distinguished from those which have been already described, by its peculiar balanced valve which can be proportioned to take any desired part of the steam pressure, leaving, if properly adjusted, just enough on the valve to hold it with certainty to its seat and to secure a little wear to give bearing and fit between valve and seat, that this valve is arranged to take steam through, and to deliver steam outside, the shell; that it has a system of perfectly flat wearing surfaces, and a positive movement of invariable extent, and thus is not liable to the formation of shoulders on seat or valve; that its clearance is so small that it is easy to counteract any ill effect, ordinarily due to that cause, by moderate compression; that it has two ports and thus possesses such advantages as may be claimed for that arrangement; that the governor is driven by a positive connection with the shaft on which it is set; that, as the cut-off is adjusted by the motion of an eccentric, the ratio of expansion is the same at both ends of the cylinder and that it possesses the advantage, common to all engines having a positive motion valve-gear, of being unrestricted in speed.

Many of these engines are already in use driving electric lighting machinery.

—— IN THE EXPERIMENTS which have been made at Grenoble for the transmission of electric force from a distance of 14 kilometres, the wire was of silicated bronze 2 mm. diameter, instead of iron as on former occasions. According to *L'Électricité* the results have been very poor, a motive power of 45 horses having been required to convey 7½ horse-power.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

XII—ELECTRIC SPARK IGNITION.

PART I, IGNITION OF ESCAPING VAPORS AND GASES.

THE electric spark, first obtained by Otto Guericke, from his sulphur globe; next by Robert Boyle, from a diamond;[1] and of greater dimensions by Dr. Wall, in 1708, from large pieces of amber,[2] has been as a conspicuous result of each progressive improvement in sources of intensity electricity, gradually reproduced, of greater and greater magnitude,[3] until it may now be artificially developed, over two feet in length, and of dazzling brilliancy.

Three distinct varieties of phenomena, namely: "igneous, disruptive, and luminous," were early recognized as associated with the passage of the spark, under determined conditions, through inferior conductors, and from the first of these, cumulative investigation has developed effects, which are now reliably utilized in the arts, both, of peace and war.

About the year 1745, ether and phosphorous were lighted by sparks from the globe machine, or the finger; brandy was lighted by first heating it; and alcohol was set on fire by a stream of electrified water.[4] Mr. William Watson was especially fascinated by this line of experimenting, during the year 1745, and in one of three letters to the Royal Society, he mentions having lighted "alcohol, spirit of lavender, sweet spirits of nitre, eau de pivonie, elixir of daffy; oils of lemon, orange, juniper, sassafras, and turpentine; and also resins, such as balsam copaiba, and turpentine, when heated, until they emitted inflammable vapor," and remarks that the spark seems to ignite only the volatile smoke.[5]

It was soon, however, observed that the less volatile spirits were more easily lighted by a spark from the end of a long icicle,[6] or by a discharge transmitted through one or

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[1] Golding. Bird. Elem. Nat. Phil. Phil., 1848; p. 75.

[2] Dr. Wall. Phil. Trans., No. 314, p. 69.

[3] Benj. Wilson. Wonderful Sparks from Hœrlem Machine. Ph. Tr., 1778.

[4] Lardner. Cab. Encyc. London, 1845; p. 17. ELECTRICIAN. Vol. I, p. 184.

[5] William Watson. Letters. Phil. Trans., 1746; p. 41, &c. Also, William Watson. Experiences et observations pour servir a l'explication de la nature et les proprieties de l'electricite proposees en trois lettres a la Soc. Roy. de Londre. Trans. de la 2me. ed Anglais. *Recueil de traites sur les electricite.* Paris, 1748.

[6] Ibid., third letter and appendix. Ph. Tr., 1746, p. 41; and 1747, p. 695.

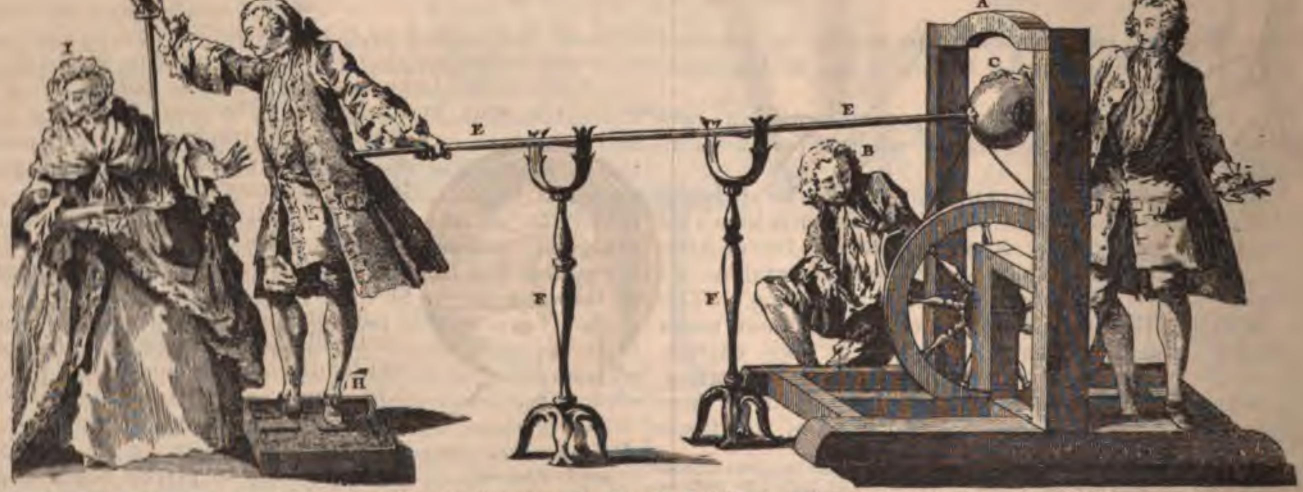

Fig. 70.—The experimenter G, being insulated by standing on a cake of rosin, is fully charged from the machine A, (of a kind much used in Holland) and applying the point of a sword to the alcohol, held in a spoon by an assistant I, he sets it on fire.

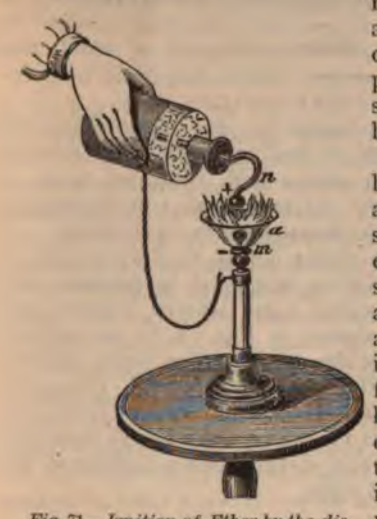

Fig. 71.—Ignition of Ether by the discharge of a Leyden jar.

more persons in its circuit, and Fig. 70, a reproduction of an illustration accompanying Watson's letters,[7] shows the ignition of alcohol by the latter method.

Ether, as is now shown by the apparatus, Fig. 71,[8] and the more volatile substances generally, being easily inflamed by the direct spark, Mr. Watson applied a spark from his finger to a stream of hydrogen issuing through the neck of a florence flask, in which he had mixed iron filings with dilute sulphuric acid, and thus first lighted a jet of inflammable gas.[9] The true nature of the gas thus produced, was not understood until long afterwards,[10] and Watson's explanation of its origin is very curious. In 1778, Mr. John Ingenhousz endeavored to make practical use of the spark for lighting candles,[11] but the development of its use in that way was rendered unnecessary, by the subsequent invention of lucifer matches.

The familiar parlor experiment of walking briskly over a soft carpet, and by a spark from the finger, thus produced, lighting a jet of ordinary illuminating gas, followed, however, its introduction in 1792, and variously produced, the spark was later applied to the simultaneous ignition of many jets, by systems which required gas burners constructed in part of insulating material. India rubber, the material used in the first of these, softened by the heat of the gas flame, and not only rendered the burner dangerously leaky, but was otherwise so inefficient, that with the inappropriate quality of spark then used,[12] not over 60 such burners could be lighted at once; yet by such imperfect means, a public building, Allen Hall, in Hartford, Conn., was first successfully lighted in the United States, about the year 1861.

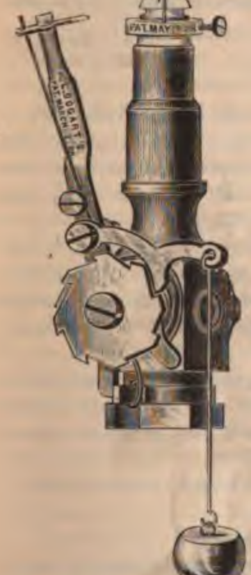

Fig. 72.—The rachet spark lighting burner.

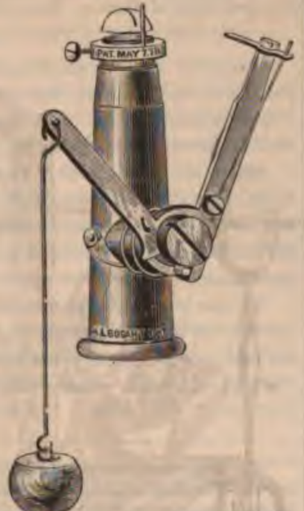

Fig. 73.—The plain spark lighting burner.

Such a system was first exhibited at the Crystal Palace, and first established in the city of New York, in the large hall of the Cooper Union; being afterwards transferred to Prof. Stone's chemical lecture room, it was found to afford so convenient a method of darkening and re-lighting the room, for experimental demonstrations, that it has been maintained, with some improvements, ever since. When first introduced, Mr. Peter Cooper frequently brought visitors to see it operate as a great novelty; but being quickly adopted by leading theatres, hotels, and public buildings, the sudden lighting by a spark, of several hundred gas jets, or great chandeliers, in most inaccessible places, became long since familiar to public gatherings, as no unusual preliminary to the beginning of an entertainment. The entire lighting in this way, of Booth's theatre, in New York, opened November 8th, 1868, was considered a triumph of skill; since, the system was extended to what are called the "movable borders," which scenic exigencies frequently change in position.

In 1871, a vitreous material being substituted for the rubber,[13] burners were constructed of which over 500 could be lighted at a flash, by a machine called a frictional battery, devised by H. Julius Smith, in 1869,[14] which develops a spark, in quality resembling that from a Leyden jar.

Single self-lighting burners appear to be a later and quite important American development, originating about the year 1872. The spark, which ignites the jet from such burners, upon the motion of the key, which turns on the gas, Fig. 72, or the motion of a supplementary lever, Fig. 73, or a press button, Figs. 74 and 75, is produced by two typical methods; either as shown in the Figs. 72, 73 and 74, the burner is designed to be connected by wire, with a distant electric source (which may be a voltaic battery in circuit with a helix and core),[15] or the spark producer (a miniature electrophorous) forms part of the burner itself. In either case the burner may be operated by a hanging cord, and is then called a pendant burner, Fig. 76, which is conveniently adapted for overhead chandeliers.

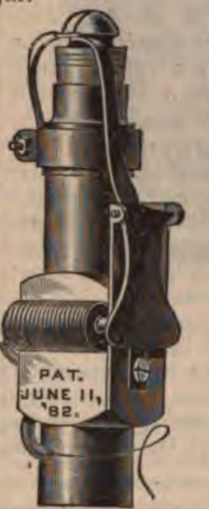

Fig. 74.—The vibrating burner.

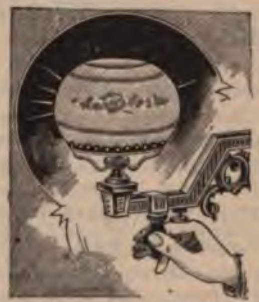

Fig. 75.—Operation of the vibrating burner.

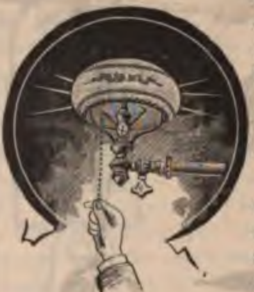

Fig. 76.—Operation of the pendant burner.

Automatic burners which, by electrical means, may be both opened and lighted or extinguished at pleasure, from any distance, appeared about the same time, and are now so far perfected as to be advantageously used in private residences. By touching a press button at the front door, or at the head of the parlor stairway, for instance, as shown in Fig. 77, the hall lamp may be instantly lighted. The cellar bracket may be lighted by a press button at the head of the cellar stairs, or a chamber burner lighted from the bedside.

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[7] Recueil, &c., p. 139, pl. III, Fig. 1. (By permission of the Astor Library.)
[8] Peck's Ganot. N. Y., 1860; Fig. 277, p. 418.
[9] Watson. Recueil, &c. P. 26.
[10] 1766. Discovered by John Cavendish.
[11] John Ingenhousz. Phil. Trans., Vol. LXVIII, 1778; pt. 2; p. 1,022.
[12] The spark from a Ruhmkorf coil.

[13] A. L. Bogart's patent.
[14] H. J. Smith's patent. 1869.
[15] In this case the spark is produced by the extra current, as described by Faraday, Proc. Roy. Inst., January 21st, 1854. Also Ex. Researches.

Fig 77.—Operation of the Automatic burner.

Not only one, but several hundred of these jets may be thus lighted or extinguished at once. As a practical test, the street lamps in a considerable section of the city of Salem, Mass., have been thus successfully lighted, during all kinds of weather, for several months, the cable being underground.[16] The burner employed for street lighting, in this instance, is somewhat larger, but otherwise similar to the usual automatic burner, shown in Fig. 78, in which the concealed mechanism is a simple electro-magnetic contrivance.

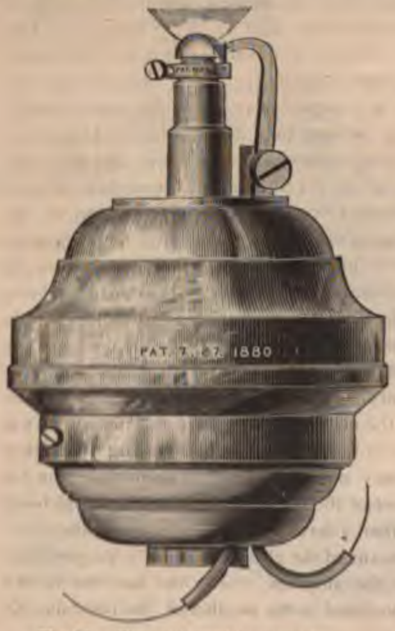

Fig. 78.—The Automatic burner.

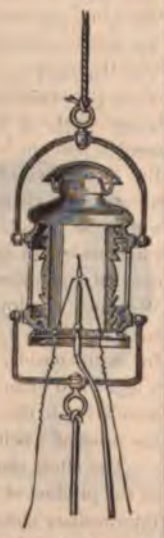

Fig. 79.—Trèves gas lantern for night telegraphy in the navy.

Automatic burners are adapted for use in combination with a burglar alarm system, so that an attempt to enter a door or window rings an alarm bell, indicates upon a register the location of the attempt, and simultaneously lights as many gas jets in the house as may be desired.[17]

The spark ignition of a single jet is so certain, that a French naval officer, M. Trève, proposed to permanently locate in the rigging of a vessel a gas lantern, constructed on the lighthouse plan, as shown in Fig. 79, to be lighted by the spark, and to replace the troublesome hand lantern now used to signal among the vessels of a fleet.[18] The automatic burner (since developed) is especially adapted for such a purpose, since by its means even the Morse alphabet may be signaled, the dots and dashes being indicated by the varying duration of the light.

THE INVENTION OF THE TELEPHONE.

Mr. Editor:

DEAR Sir—During the Autumn of 1881, while making the tour of the Rhine, I took occasion to visit the pretty little German village of Friedrichsdorf, famous for being the home of Philipp Reis. There is located the Garnier Institute, where Herr Reis was for fourteen years its able instructor of physics; saw in his laboratory many skillfully constructed pieces of apparatus, the work of his own hands; was introduced to, and conversed with, many of his former companions and co-laborers, by one of whom I was escorted to the neighboring cemetery, where the Physical Society of Frankfort have erected a beautiful monument of red sandstone, as a tribute to his discovery of the telephone.

I was disappointed in not seeing Herr Heinrich Peter, who, I was told, was conversant with the work in telephony done by Reis. Soon afterwards I wrote to Herr Peter, concerning those experiments, and received in reply a very interesting letter, an accurate translation of which I enclose for publication. I remain, yours,

H. C. BUCK.

Boston, Sept. 21st, 1883.

FRIEDRICHSDORF, October 17th, 1881.

Respected Sir:—I much regret not having been able to converse with you when you were here, but gladly accede to your request, and state that I was present at the experiments of Herr Reis, and can testify that audible speech* was actually reproduced by his telephone.

Many members of the "Physicalischer Verein," of Frankfort-on-the-Main, who also witnessed, once or twice, the experiments of the inventor, will certainly be ready and willing, for the honor of Herr Reis, to confirm the above, and a multitude of proofs can be furnished, if it would repay your interest to come here again.

In case you should purpose to call on me again, I will remark, that I am to be at home constantly from now on, and shall be on the lookout for your valued visit, if you will let me know of it a day or two in advance. With much regard, yours respectfully,

H. F. PETER, Music Teacher.

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[16] Report of Committee on Lamps, &c., Salem, 1877.

[17] For much of this information, and for cuts, acknowledgement is due to Mr. A. L. Bogart, of New York, and Mr. Louis W. Burnham, of Boston, Mass.

[18] Guillemin. Applications of Phys. Forces. Trans., London, 1867; p. 698.

* The words, translated "audible speech," are in the original, "*wahrnehmbare worte.*" "'*Wahrnehmbar*' is literally 'perceptible;' '*worte*' (words), are the audible expressions, when they express a connected idea in a discourse." See *Eberhard's Synonomisches Handwörterbuch der Deutschen Sprache*, p. 741.—TRANSLATOR.

OUR PARIS CORRESPONDENCE.

PARIS, Sept. 1st, 1883.

I am beginning to fear that I was a little too hasty in expressing an opinion, in the beginning of the year, that the Vienna Exposition would aid in a revival of electric industries. The public, in fact, are taking less interest in them every day, and nobody has the temerity to try and react against this indifference. M. Phillipart, indeed, continues his experiments on the Boulevards with the electric traction of tramways by means of accumulators, but although he invites very prominent people to these exhibitions, he does not succeed in convincing anyone of the advantages of his system. The mistrust displayed towards him may be explained, however, by the failure of his former enterprises; it, however, has another cause, in the financial stringency in which the Paris market has been since the *Krach*. But France is not the only country in which electrical enterprises are neglected. We have only to turn to the English papers, to find that there is a deplorable reaction on the other side of the Channel. The Vienna exposition will not succeed in reviving the enthusiasm that was looked for by the first exhibition of 1881. It will, indeed, offer a very remarkable *ensemble* of discoveries and practical applications, but the same implicit faith, that has so materially assisted progress, will not be found among the visitors.

The era of great discoveries is closed for a few years, and the revelations of genius will be followed by patient investigation, improvement in details, and studies in detail matters that can only be properly appreciated by men in the business

In this line, I have to mention the oxide of copper battery of Messrs. Lalande and Chaperon, and the magneto-electric call of M. Abdank Abdakanowicz. I send you a full description of the battery, with the results of the tests that have been made with it. I need not insist on the advantages it presents for use in telegraphy, telephone systems, and electroplating. The magneto-electric call does away with batteries in the office of the subscriber, and works admirably for distances of several kilometres; its cost is only from 28 to 30 francs. It is a very ingenious application of alternate currents produced mechanically.

An article appeared, recently, in *L'Electricien*, on the cost of power furnished by the hydro-electric batteries. M. Reynier proves that the cost of the horse-power hour is so great with these apparatuses, that there is no chance for using them profitably, either for illuminating purposes or for the production of electro-motive power.

But even the figures he gives, appear to me to be too favorable. On one hand, he calculates the theoretical power, and while he reduces it by introducing the useful co-efficients, he does not take into sufficient consideration the local actions that modify the yield in such a great degree; on the other hand, he gives a value to the residuums that they have not, placing them at 20 to 25 per cent. of the cost of the raw material. It must not be imagined, that when a battery is exhausted it would pay manufacturers to have the copper that is left extracted. In Germany, the telegraph department sells the waste from the batteries at nearly 20 per cent. of the first cost, but this is possible for a government institution, in which general expenses and labor are of secondary importance; it is another thing for the manufacturer who is obliged to adopt the most economic system. It follows, that the results stated by M. Reynier must be considered as a minimum, below which we must not think of going, and that the general expenses and cost of labor must be added.

I have no intention, in saying this, of condemning the electric batteries, but simply to warn the reader against the misleading idea that the sub-products can be regenerated or utilized. M. Phillipart, only to mention one of the most daring electric financiers, knows the cost of such a dream.

Another idea, that is scarcely less dangerous, although *savants* have helped to make it popular, is that of utilizing the tide power for the cheap production of electricity. The best process would be to create tanks or dams, taking advantage of the configuration of the ground, and storing up the water at high tide, and have it act at low water on hydraulic wheels or turbines. The first cost of establishment would certainly be very great, and there might be difficulties in working, but this system is rational in theory, but it has not been sufficient for inventors who have been lately bringing out the strangest plans. I will mention, as a curiosity, the system lately patented by M. de Souza.

It consists in utilizing the horizontal push of the waves on the shore, by receiving it on vertical wooden or sheet iron frames, having for each machine a total surface of about 30 square metres, and held in place by springs which yield under a certain pressure and allow the frames to incline when a wave is too strong. In addition to this, supplementary shutters, or wings, are placed in front, and moderate the first shock of the wave and prolong its action. These frames are carried by rolling cars on the ground, and running on rails. The dead weight of the whole is counterbalanced by floats. The advance and retreat of the waves give the frames a motion like that of the piston of a steam engine. The motion is transmitted to the mill by metallic cables or chains. This method of transmission allows the apparatus to follow the tide, as the cars can be moved at will to any point of the cables. The displacement is obtained in the mill by a simple lever work. The cable ends by a connecting rod with a strong wheel. The joints of the connecting rod at the wheel are movable, and thus the machine can be adapted to any state of the sea. There is, in fact, a movement that is regulated by the fly-wheel and the system of frames, and which actuates electric machines that give a regular current and work.

The inventor claims that his system is very simple, and that it meets all the inequalities and exigencies of the power collected. He tells us about the power given by waves, but he forgets to take into consideration two indispensable factors in the economical production of power—the space traversed by the point of application of the power, and the time required for traversing it. We must frankly admit that we do not understand how the mechanism can work, and so we will not discuss its details.

Before wanting to utilize the tides and natural forces, it would be well, perhaps, to ask whether electricity is capable of fulfilling the programme that has been traced for it. It would not be sufficient to merely transform the power of the waves into electric currents on the sea shore, for we could not expect industrial centres would be removed for the simple reason of getting motive power cheaply—as this has been fully proved by the failure of the attempt to utilize the falls of the Rhone at Bellegarde—it would be in order, therefore, to determine to what distance electric power can be effectively distributed. The choice even of terms in describing the phenomenon is not an indifferent matter, and, in the interest of electricity, it is better to adopt the expression *transmission of power* than *transport of power*. People might think that this is a subtility of language, but by no means, and we will give our reasons for the preference. The electric current in this special application, produces effects similar to those of machine belts and telodynamic cables, and, as in these mechanical agents, the width or the diameter is in proportion to the effort that is to be received. The diameter and the material of the electric conductor exert a great influence on the industrial yield of the dynamo machines. These elements must be taken into account, while the term transport of power is calculated to make the public overlook this, and to believe that distance has nothing to do with the matter. Doubtless it can be shown by calculations that the yield of electric machines is independent of the distance between them, that is to say, that if the distance is doubled or trebled the construction of the machines might be so modified as to obtain the same return as previously. But these theoretical reasons are inadmissible in practice, as they would necessitate a change in the machines at every change of distance, and this would be a bad system. It is better to regard the matter as a simple transmission of power. We have machines that give a yield of 50 per cent. at 500 metres, and we wish to have the same return at 2,000 metres. We must employ an intermediary conductor that has the same resistance for 2,000 metres as that which the old conductor has at 500 metres. It is for us to consider whether there is reason to go to this expense, or whether a less yield than 50 per cent. may not do. There is no more reason for wondering in this case at the cost of the conductor than there would be at the price of a belt or a cable, when a certain effort has to be obtained.

The effort transmitted by means of the electric current is proportional to the product of the bolts by the ampéres, or $e\,i$; the loss due to the intermediary conductor is proportional to the product of the resistance by the square of the intensity, or $r\,i^2$.

We may try to lessen this loss by employing currents of very high tension (e) and of weak intensity (i), but we cannot exceed a tension of a few thousand volts under penalty of death to the persons handling the machine. A current of 3,000 volts and 3 ampéres, at the outset, of the generator dynamo correspond to only about 800 kilogrammetres, or 12 horse-power, and consequently, under the most favorable conditions, even no more than six horse-power will be collected on the receiving machine. The work under such conditions would be unsatisfactory, and it would be necessary to combine the volt-ampéres in some way so as to obtain something better. 1,000 volts and 30 ampéres, for instance, are equivalent to 3,000 kilogrammetres, or 40 horse at the start, and the receiver would give some 20 horse-power—if the conductor does not take too much on the way. Let us suppose that the conductor has a resistance of 1 ohm per kilometre, we are sure to lose under this head at least 90 kilogrammetres per kilometre, and if we do not want to lose less, as the intensity is constant, we must decrease the resistance, that is to say, we must use a dearer conductor.

People who dream of utilizing the tides, do not imagine the difficulties they would have, in case of success, in employing electricity to any advantage Currents of high tension—5,000 or 6,000 or more volts—make a very good showing in scientific articles, and give a solution on paper of the problem ; but, when an industrial use is in question, their great danger is soon recognized.

We cannot say whether these currents may or may not be used in practical work. M. Marcel Deprez, who has done so much to make the transmission known, does not, perhaps, despair of succeeding some day, as he is continuing his experiments most perseveringly ; he is now following up some experiments at Grenoble, but we hear only of his fittings up. The dynamo-electric machines are those that were used in the trials on the Chemin de fer du Nord. The generator is established at a fall of water, some 14 kilometres from the city ; the electric current is brought by an ordinary telegraph wire, and the receiver is in the market house of Grenoble, where it actuates small motors, pumps, glove sewing machines, etc. It will be interesting to know, and this is easily ascertained with pumping, what the effective yield is on the receiver, under known conditions of duration, etc. We have criticised the ideas of M. Marcel Deprez on several occasions, but we would be happy to be able to acknowledge the utility of his work.

Although the time is not very favorable for the formation of companies, M Achard, the inventor of the electric brake that was exhibited at the exposition of 1881, has formed another company for working his patents To speak of electric brakes after the adoption of the remarkable invention of Westinghouse by the majority of railroads in France, England and the United States, and with the vacuum brake of Smith, to speak of any new brake with these competitors is to preach in the desert ; but Mr. Achard has the unshakable faith of the inventor. He has the ill fortune to be ahead of his time. The electric brake saw its birth in France some twenty years ago, at a period when very little thought was given to the question, and it has been vegetating since without any important application. It is thought that the electric current supplied by the batteries does not offer sufficient guarantees of working well ; accumulators or small dynamo-electric machines that can be depended on have been substituted for the batteries, but other difficulties have been encountered—thus, on an Eastern train on which an experiment was made, there was a great deal of trouble experienced in unwedging the blocks of the brake, and a delay of several minutes was caused. Mr. Achard has overcome these objections, and the electric brake comes but too late for the railway companies, which have put either the compressed air or vacuum brake on their cars. Electricity would not do any better than they, and this being so, why overburden the engine driver by giving him an apparatus that he does not understand. It would be a regular education to undergo, and at the cost of the traveling public ; nobody thinks so much of electricity as to try this experiment.

I have to inform you, in closing, that the new Hotel de Ville will be lighted by the Edison company with their incandescent lamps, and a credit of 100,000 francs has been voted for this purpose by the Municipal Council. The Théâtre Gymnase will have the electric light in future, and I shall send you some particulars about it in my next.

PH. DELAHAYE.

OUR VIENNA CORRESPONDENCE.

VIENNA, Aug. 16th, 1883.

To the Editors of the Electrician:

THE great exhibition was at last opened to-day, notwithstanding the unkindness of the weather-gods who surrounded the whole building with a creamy pool of mud—and the tardy exhibitors, many of whom were not ready with their exhibits. His Highness, the Crown Prince of Austria, together with many other dignitaries with many titles, performed the opening ceremonies from the Emperor's pavilion, surrounded with orange and laurel trees, men of rank and titles, and reporters of the press. The public, being entirely ignored, had to remain at such a distance that they could only imagine what was going on. The uncovering of all the heads and the playing of the national hymn by a military band, announced that the speeches were finished, and that His Highness was about to pass through the crowds of people, and make his tour of inspection through the building.

In making a hasty trip through the building, one cannot help being both interested and amused at the many useful and ingenious applications of electricity, the rich and costly decorations, the brilliancy of the light, the many dynamos and motors from the 10-foot machine of Ganz & Co. to the buzzing little dental engines; the different processes of generating the current from the passive energy of coal, gas, chemicals, besides the energy of wind, water and man; the final use of the current in the many different ways, from the delicate Thompson syphon recorder to the driving of hugh lathes, and the running of heavy cars over the electric railroad.

The number of interesting objects is so great that we will be limited to a mere mention of some of them in this letter; a more detailed description of some of the more important will follow in another. Beginning with the generation of the current—there are in one of the courts, numerous boilers of all sizes and descriptions, having a heating surface of over 23,000 sq. ft. Of the engines there are also a large number, the little high speed engine driving the Edison machines much larger than the engine itself; the large low speed German engine, with the quick cut-off principle of Corliss; the buzzing little rotary engines, shaking itself and the surrounding floor all to pieces; the silent (?) gas engine, besides two caloric engines. Near the North entrance is a four-horse power windmill, with a small dynamo and accumulators, together with lights, machines and farming tools, to be driven with the stored-up energy of the wind.

The dynamos, of which there are a very large number, appear to be all of the same standard types, being improved only in details of construction, change of proportions, etc., but, as many of them are not yet ready for exhibition, it may be that there will be something quite new when the exhibits are all finished. One improvement, although not new, deserves notice, it is the placing of a strong electro-magnet inside of the Gramme ring, thus utilizing the wire inside of the ring, which, in the Gramme machine, serves only as a conductor. The large 10 ft. circular machine of Ganz & Co., Budapest, attracts a great deal of attention. It is driven directly by a large vertical engine making only about 54 revolutions per minute, but owing to the large diameter of the ring the linear velocity at the circumference is quite great. Whether it is very efficient remains to be seen. Of all the dynamos the American form a large proportion.

Of the application of the current there is an almost unlimited number of exhibits. The French telegraph instruments are the most interesting of that class. Among the many instruments are several different, easily managed printing telegraphs, also rapid telegraphs in which the message enters the receiver as a perforated strip of paper, similar to our rapid system. Besides these are several forms of instruments for telegraphing pictures, signatures, etc. The telephones exhibited are also very interesting. Through those connected with the opera house the different voices of the singers can be heard so distinctly that one is tempted to applaud and call for an encore. Another set of telephones is connected with two small towns, 85 kilometres (about 53 miles) apart, the vocal solo in one town being accompanied with a piano in the other town. The performers have caps covering their heads, and containing the receivers, so that they can hear each other.

The transmission of power is very well illustrated. Besides the electrical railway and the coal transportation over the building, there are several machine shops, a printing press, on which exhibition news is printed; dental instruments, telegraph instruments, besides many others, all driven by electrical energy.

Among the electrical measuring instruments—of which the French have the best exhibit—there is much new and improved apparatus. One instrument made by Hartman, in the German department, is of special interest. It is a Wheatstone bridge, in which the telephone is used instead of the galvanometer, the telephone being in the secondary circuit of an induction coil. The advantages are, that resistances can be measured accurately in a very short time, the scale being graduated for reading the resistances directly. Another instrument is for demagnetizing watches and other instruments which have been magnetized. It consists of a small stand, around which the currents may be made to pass in all possible directions. In the building, are sold (at 8 cents apiece) small, neatly finished wrought iron cases, for enclosing the watches of visitors, to prevent them from being magnetized by the many electro-magnets. When you buy them you are told that "they are said to be effective;" however, in testing their efficiency, we would prefer to use some other person's watch in preference to our own.

Electrical military appliances are also well exhibited. Among them are large light-house reflectors (Mangin), small dynamos (Gramme), rotary engines, telegraphic instruments, etc., for sending powerful beams of light in any desired direction, and running temporary telegraph wires—all mounted on wheels for easy transportation.

Among the many applications for medical purposes is an electric bath tub, in which one pole is connected with plates, so arranged on the sides of the tub as to prevent an unexpected and unpleasant contact with both poles at once, without the resisting and distributing action of the water.

Thermo-electric batteries; safes with electric alarm locks; railway appliances; miners' lamps, lit by small incandescent platinum coils; dead-finish electroplates; electroplating embossed metallic ornaments, with different colored metals; a set of 320 small Planté cells, with apparatus for connecting them in series or arc, for converting dynamic into static electricity; besides innumerable other contrivances and inventions, are among the remaining attractions of the exhibition.

CARL HERING.

P. S.: Sept. 4th.

The latest news here is, that the evening openings have begun, and are the great attraction to the public The transmission of power in the railroad, the cable road for carrying coal, and the running of a machine shop, are all in good working order now. The telephones from the opera and concert halls are very successful. The illumination is grand, most of the many hundred lights being now in order. Unfortunately, the two 75 ft. iron towers with five arc lights, standing in front of the building, were destroyed by the wind on Sunday (Sept. 2d) evening. The two large reflectors on the top of the building, throwing a comet-like beam of light over the city, are very successful, and attract considerable attention. The theatre performances will begin soon. The scientific lectures have begun, being opened by the distinguished Sir Wm. Siemens, of London. C. H.

THE AMERICAN EXPOSITION AT BOSTON.

To the Editor of the Electrician :

AT the Foreign Exhibition, in the building of the Massachusetts Charitable Mechanics' Association, electricity is not represented among the exhibits; but both visitors and exhibitors derive a great benefit from its applications. There are the messenger call boxes, and a telephone office; while the electric light makes an evening visit as satisfactory as one by daylight. The general illumination of the rooms open to the public is by the American company (Thompson-Houston system), who have a permanent station in the basement. A local photographer uses four of the lamps to accommodate his patrons after dark. The Edison company have about one thousand lamps, and light the art galleries. Some of the pictures show out with remarkable distinctness, with little apparent loss from lack of daylight. Most of the exhibitors, who require more light than the arc lamps furnish, prefer the incandescent lamps to gas, though a few use both. It seems odd to see gas flames in the Edison dynamo room. They apparently feel out of place, for the draft from the belts makes them flicker and dodge, as if they expected to be put out every moment. The steadiness of the incandescent lamps is very marked in comparison.

At the American Exposition, in the building of the New England Manufacturers' and Mechanics' Institute, the electrical exhibit is not so extensive as that of a year ago. The E. Howard Watch and Clock Co. show one of their electric watch clocks—that is, a clock to watch the watchman much as the conductor's punch ensures his honesty. In this system the clock and register are set up in the office, and the watchman in making his rounds is required to wind up a series of circuit-closer boxes, scattered about the works. As each of these runs down it records its number upon the register, and the time the watchman was present at each box can thus be known. In the same clock which carries the register there are arranged a series of adjustable circuit-closers, by means of which bells can be rung in the different workrooms at certain fixed times, so that all may begin and end their work at the same moment. By another attachment, the clocks about the various buildings can be hourly synchronized, or set to agree with the office regulator.

The most prominent feature of the electrical exhibit is the electric light, by which the building is lighted even more thoroughly than that of the Foreign Exhibition. With one or two exceptions, the exhibitors find the general illumination sufficient. The art galleries are lighted by the Maxim lamps, of which four hundred are used. They are far superior to the ordinary gas flame. In the concert hall, having an area of twenty-six thousand square feet, there are twenty-one Fuller arc lamps, which give a very clear white light. The same exhibit in the lower hall includes a locomotive headlight, which causes a universal winking of the eyes, as visitors turn suddenly upon it. The Fuller Company show samples of every size of machine, from one-light to twenty-five, in running order; and also their semi-incandescent system, for the use of those who desire a light of a less intensity than that of the arc lamps. About the main exhibition hall are scattered two hundred of the Thompson-Houston lamps. These are supplied by six dynamos, each with its controlling regulator mounted upon it, a feature which seems to be peculiar to this system. Their tower, outside the building, upon which are nightly hoisted eight lamps, is a prominent beacon for miles around.

The different types of engine used for running the electric light machines are nearly all represented here, from the ponderous Corliss to the high speed Westinghouse. As any change of speed is a serious defect in a motor used for this purpose, the governor is an important feature. Naturally, all have an automatic cut-off. Those who make engines which are controlled by variations in speed alone, claim a greater steadiness than can be found in those engines in which the variation in the load acts directly upon the cut-off, and *vice versa*. The advantage of the former system seems to be that the governor, having less work to do, is more sensitive; but, apparently, the latter would permit of greater changes in the work to be done, without readjustment.

FRED. W. STONE.

Somerville, Mass., Sept, 18th, 1883.

TESTING UNDERGROUND CONDUITS.

A LARGE party of interested spectators gathered at 2040 Market Street last night to witness the first public exhibition of the Morse Electric Underground Conduit System, which has been in practical operation for some time. Among those present were a number of councilmen, including members of the police and fire alarm telegraph committee, which has the question of underground telegraphy in charge on behalf of the city. In addition, a number of scientists connected with the Franklin Institute, and other organizations of a like character, were engaged in an inspection of the system presented to them. The general verdict was favorable on all sides, and it was the expression of the members of councils that the Morse company had developed an operation which was as much, if not more, practicable than any of the schemes in underground telegraphy yet brought before the public.

Last evening the working of the conduits was to prove the practicability of transmitting electric light, telephonic and telegraphic communication in one inclosure without any loss or interference by induction, which has been the great bugbear of all overhead as well as undergound telegraphy.

The patent rights of the Morse company are based upon the following principles: The wires to any number, or for any purpose, are encased in glass tubes, glass being the best non-conductor known, and these tubes are enclosed in cement made of dead material, which absorbs all moisture, and prevents expansion or contraction. In this state the whole plant is placed in an iron pipe, the size of which is regulated by the number of wires to be used. The system can be laid close to the curb, at a depth just below the frost line. Connection to dwellings or business houses are provided for at intervals of sixteen feet, and it will not be necessary to disturb the streets to reach consumers. By an ingenious mechanical device the electric light can be furnished at a residence, and turned off or on quite as readily as gas or water. The main point made by the company is, that when the conduit is once laid it is there for good, and any connections which are required to be made will not necessitate any disturbance of the street pavement.

At the exhibition last night, an engine of ten horse-power furnished the power to a dynamo machine, and the hundreds of inquisitive spectators amused and instructed themselves with the various appliances offered for their consideration. Three electric lights, one of 4,000 candle power, and two of 2,000 candle power, each burned brightly and with a steadiness which has not been excelled, or hardly equaled, heretofore. At the same time, talk was flying fast and furious over the telephones, and messages of interest were being sent by the councilmen over the wires by telegraph. Probably the most practical councilman in the municipal government is Mr. Marshall, of the Twentieth Ward. He appeared to be very much interested in the showing of the operations, and remarked that he considered it to be altogether practicable, and saw no reason for its non-success. He particularly spoke of the absence of the usual flickering in other electric lights, which he explained was due to the impossibility of reaching a ground current through the crossing of the wires. Among the visitors was Judge Walter Cummings, of Wilmington, Del., representing a company of that city now negotiating for the use of the Morse system throughout that State.—*Philadelphia Press*, Sept. 21st

CLAIMS TO THE INVENTION OF THE TELEPHONE.

A CORRESPONDENT sends the following interesting communication to the London *Electrician :*

" After the able manner in which Professor S. P. Thompson has put forward the claims of Reis as the first and true inventor of the telephone, as opposed to those of Bell, it is rather surprising to suddenly come across a publication to the effect that the labors of both these men have been anticipated by one Charles Bourseul in 1854. The publication in question is a lecture delivered by Captain Holthof, in April, 1881, to the Electrical Society of Frankfort, and will be found on page 48 of that society's *Journal*, which, for some reason unknown, has only just appeared. The fol'owing passage, quoted from the lecture, will be read with interest : ' If we agree to call the true inventor that man who is the first to conceive, clearly, a new idea, and who tells us how this idea can be carried out in practice, then the telephone was invented in 1854, by Charles Bourseul, a Frenchman, and about that time a soldier in the African army.'

" We learn further, from the same source, that the invention had been communicated, in 1854, to the French Academy, and that more or less detailed descriptions of it went the round of the German papers of that period. Notable in this regard, is one article which appeared on the 28th September, 1854, in the *Didaskalia*, a supplementary paper to the *Frankfurter Journal*, which sets forth the very gist of the invention so clearly, that, in spite of its ancient date, a short abstract from this paper may be interesting to our readers : ' An electric current, passing through a wire, transforms a piece of soft iron into a magnet. If the current ceases, the magnetism also ceases. This electro-magnet can be made to alternately attract and release a movable plate, which, in its to-and-fro movements, produces the conventional telegraphic signals. Now, it is also known, that all sounds which reach our ear are produced by vibrations in the air, and that the infinite variety of sounds depends solely on the speed and magnitude of these sound-waves. If, now, a metal disc could be invented, which would be flexible enough to reproduce all the sound-waves transmitted to it by the air, and if that disc could be connected to an electric circuit—such a way that, in conformity with the vibration of the air, it would start and interrupt the current—then it would also be possible to cause a similarly constructed metal disc, in electrical connection with the first, to repeat all the movements of it, and the effect would be the same as if one had spoken directly against this second disc; that is to say, the ear would be affected in the same manner as if it heard the speech directly through the first metal diaphragm '

" Captain Holthof considers it very astonishing that Reis did not know of Bourseul's invention, but infers this to be the case, as otherwise he would have introduced, at once, the second diaphragm. As regards Bell, the lecturer thinks it ' downright incredible ' that Bourseul's labors should not have been known to him. In conclusion, Holthof suggests that Bourseul should be recognized as the father of the telephone."

We may add, that the claims of Bourseul, in this direction, have had a most notable advocate in M. le Comte du Moncel, the well-known and prolific writer on electrical subjects.

VIENNA NOTES.

—— SELLON-VOLCKMAR accumulators supply the current for the incandescent lamps in the Imperial pavilion, and a few elements are used for lighting two incandescent carriage lamps. The carriage is exhibited by Jacob Lohner, of Vienna. The battery is placed under the coachman's seat, and also works an ingenious contrivance, which informs the owner if the coachman has admitted a stranger into the carriage during his absence. On leaving the carriage the owner, by means of a key, opens the current; as soon as a third person takes his seat contact is made by the weight of the intruder, a bell begins to ring, and keeps on ringing the whole of the time the stranger remains seated, and a white disc appears on the back of the box, which the owner alone can remove with his key.

—— A VERY INTERESTING telephone is exhibited by Mr. Ericson, of Stockholm; it is intended for a limited number of subscribers (not more than five), living at some distance from a central station, and replaces a second station, which would necessitate the employment of at least one clerk. By means of this apparatus the correspondence between two of the five subscribers, or between one subscriber and the central office, is effected from the latter. There is one main line between the central station and the, as we may call it, secondary automatic switch board, which is put up at any place at or near the residence of the five subscribers, and from it a separate short line connects each of the five subscribers with the automatic switch board. If one of the five subscribers calls, the call is heard only at the central office, where a bell rings and an annunciator falls, exhibiting the number of the calling line. After this, the clerk at the central office has to ascertain which of the five subscribers has called, and this being done, communication may be established between the caller and any other subscriber of the central station. As long as connection is made, neither of the other four bells can ring, because the connection is interrupted at the automatic switch board. As soon as the conversation is finished the clerk at the central office re-establishes the original connections, and the station is ready for a fresh call. A number of these secondary automatic stations can be controlled from one central office, and the saving of conducting wire, and also of carbons, is considerable.

—— AMONG THE MANY STRIKING OBJECTS at the Vienna Electric Exhibition is Messrs Lautensack and Bittner's thermo-electric battery. The principle of these batteries is the direct transformation of heat into electricity without passing through the intermediary stage of work, as in the case of the employment of a dynamo. Great promises were held out some three or four years ago, on the construction of Clamond's coke heated thermo-electric stove, that this most important problem was advancing toward at least a partial solution; but nothing further was heard of it, and no advance whatever has been made since in this question.

Messrs. Lautensack and Bittner exhibit a thermo-electric stove, which presents the form of an ordinary stove, and can be used as such. It consists of thirty superposed concentric rings of thirty-two elements each, the rings being insulated from one another by means of asbestos. The elements consist of an alloy of two electrically opposed metals (the patent not being completed, the inventor would not tell the exact composition), which fuses at 609 degrees C.; on heating this alloy an electric current is generated. The combustion stove is placed in the centre, and a considerable space separates the stove from the concentric rings, so that the heating of the alloy is not effected direct, and the temperature to which the alloy is heated does not exceed 300 degrees to 400 degrees C. Each concentric ring has its own terminal screw, so that the whole or part of the current can be used. The current has an electro-motive force of twenty volts and twelve ohms resistance. The battery is intended for galvanoplastic, but (and this is an important point) if the stove, as is the case in winter, is kept burning all day, sufficient current power can be obtained to charge a number of accumulators sufficient for domestic lighting purposes, or to drive a small motor for doing domestic work, without any extra expense.

—— TREATING OF RAILWAYS, there are a number of important apparatus used by the Imperial Austrian State railways, and invented by the Chief Inspector of Railroads, Herr Pollitzer. They are:

(1.) A central point blocking apparatus. The object of this apparatus is to control any pointsman from a central office and to prevent him from showing the line clear until ordered to do so by the central office. It consists of a small box and a manipulator. The box has an electric bell at the top and two circular openings in front, exhibiting, in their turn, the two different directions of a train. On the train being announced from the nearest station, the person in charge at the office presses a stud beneath the opening indicating the direction of the train; the pointsman answers the signal; the points are now set by the manipulator from the central office, and simultaneously the lever for the semaphore signal is electrically released, enabling the pointsman to show the line clear.

(2.) Intermediary blocking apparatus and speed measurer. The apparatus consists of a clock case, containing a clock work and sector of a dial and two glass covered circular openings above the clock. The train—generally the last carriage—has a small brush attached to a lever, which presses the brush against a brass contact piece placed on the line, close to the rail, at the beginning of one section. When contact is made, a red disc appears in one of the openings, and the clock begins to move. At the end of the section a similar contact piece causes another red disc to appear on its respective apparatus, stops the clock movement, and removes the disc of the preceding one. The distance through which the clock hand has moved over the sector indicates the speed of the train. As long as the red disc is exhibited no train can move in either direction.

(3.) Central disc for signaling. On a disc are inscribed different numbers of signals for passenger and goods trains, and a switch board above the disc exhibits these different numbers on the fall of an annunciator, which is caused by the setting of a contact arm, movable over the disc, on the respective number of the train. All the trains moving on the line are controlled by electric semaphores, which show the line clear only on the appearance of the number of signals characteristic of a special train. As soon as the train has left the section, the official at the station turns the contact arm to the place indicated on the disc for that train; the annunciator of the corresponding numbers on the switch board falls, and all the semaphores of the section show the line clear.

(4.) Apparatus for closing railway gates for foot passengers. The object of the apparatus is the automatic lowering or raising of a gate, closing the footpath across a railway line by a mechanism worked electrically. An electric bell, worked by a signalman at some distance from the gate, informs the foot passengers of the approach of the train; and, by the same operation, the gate is closed electrically by the release of a clock train, which moves a jointed lever arm through an angle of 90°; when the train has passed, the same manipulation opens the gate by completing he movement of the lever arm.

(5.) Station indicator. It is no small boon for passengers traveling by express train over long distances to know the name of the nearest station at which the train stops sufficiently long to take a meal, buy a paper, etc. Herr Pollitzer places in every carriage a small box exhibiting in the corner the name of the next station, with the time allowed for stoppage. The guard has simply to press the stud of a similar box placed in his van some time before the station is reached, and every box shows the name of the next station, with the time allowed for stoppage. The battery for railway inter-communication, which is rarely used, can be employed for this purpose.—*Vienna Correspondence, London Times and Telegraph.*

ELECTRIC LIGHTING OF THEATRES.

AMONG the applications of electric lighting, there is one to which, a series of catastrophes occurring during the last few years, has especially directed public attention—namely, the employment of the incandescence electric lamps, which now exist in great variety, for the lighting of theatres and public buildings.

To avoid or diminish the danger of fire, so liable to arise from the use of the naked gas flame, it would seem that nothing better could be wished for than the filament of carbon, protected by its globe from contact with the surrounding air and neighboring draperies; and it appears to us, that this recommendation alone justifies its substitution for the gas flame, especially, as in this particular case, it is not sensibly more expensive

But, encouraged by this undeniable advantage of electric lighting, its partisans have also claimed for it numerous other advantages, without troubling themselves to ascertain whether they are to be realized in practice, or whether the conditions of its use authorize them. Among these, the hygienic hypothesis is a favorite recommendation. Electric lighting, they say, must contribute to the maintainence of a mean temperature in the hall, and preserve the purity of its atmosphere—forgetting, that although the combustion of gas is accompanied by the development of both heat and carbonic acid gas, the spectators themselves contribute, in a far greater degree, to transform the hall into a hot-air chamber, and to render the atmosphere irrespirable. They have, therefore, overestimated and confidently asserted the virtues of electricity from the point of view not only of its security, but of the salutary advantages it offers to theatregoers; instead of recalling the terrible disasters of the Ring Theatre, at Vienna, or of the theatre at Nice, they represent the electricity as transforming into sanitary retreats the unsubstantial temples of the muses, where good taste requires one to be seen of an evening. Undoubtedly, some degrees less of heat may be attributed to the use of electricity, but we shall show that all the promises made in its name must not be taken to the letter.

Prof. Von Pettenkofer has pursued a series of experiments upon the influence which lighting by gas and electricity, respectively, exercise upon the temperature and the composition of the atmosphere of an auditorium. The theatre of the royal residence at Munich was chosen for the purpose.

The increase of temperature, when the hall was empty, was ten times greater in the upper galleries with gas, than with electricity. In the first case, the temperature increased 16.5° F. = (9° C.), and in the second case, 1 6° F. = (0 9° C) In the intermediate and lower galleries, the difference was less.

When the hall was filled with people a difference of but 10.8° F. (6° C.), was detected, the thermometer indicating in the galleries, 84° F. with the gas burning, and 73.2° F. with the electric lights. It was as warm with electricity in the third balcony as in the first with gas.

He determined, also, the amount of carbonic acid. In the empty hall, when the air was vitiated only by the products of the lights, the results were of the same order as in the case of the temperature. In the beginning, the proportion was four ten thousandths. The gas being lighted, it attained in half an hour, five ten thousandths in the parquette, eleven in the first, and twenty in the third balcony.

With electricity, after half an hour of illumination, it was five ten thousandths in the parquette, five in the first, and six in the third balcony. If, as is probably true of incandescent vacuum lamps, the electric light is not accompanied by the production of carbonic acid, the slight difference observed can be attributed only to the presence of the experimenters. But, unfortunately, this superiority is not maintained when the hall is filled with spectators. For five or six hundred persons present, the maximum proportion of carbonic acid was twenty-three ten thousandths, when the gas was used, and eighteen ten thousandths with the electricity.

Reasons may be given to explain this apparent contradiction. The scenery being constantly shifted, causes frequent agitation and changes of the air in the hall. The doors, boxes, and windows looking upon the street, are constantly opened, and the incessant partial renewals of the atmosphere thus produced, render the conclusions which might be deduced from the chemical analysis of the air, more or less illusory.

Prof. Von Pettenkofer's labors simply prove that the ventilation of public establishments is deplorable.

Upon this point, "electriciens" and "gaziers" are in accord, and it may afford us the rare pleasure of seeing them unite, though it be for the purpose of jointly attacking the architectural profession with well-merited reproaches.—*Revue Industrielle*, of Sept. 5, 1883.

ELECTRIC CARS IN PARIS.

An electric tramcar trial was successfully accomplished recently in Paris by the French Electrical Power Storage Company. At three o'clock the vehicle, an ordinary three-horse tramcar, left the Place de la Nation, in the far east, and after traversing the capital through important thoroughfares reached the starting point soon after six o'clock. A distance of thirty English miles was thus made in about three hours. The mute wonderment with which the soundless progress of the apparently animated car through the crowded streets was witnessed by the public may be imagined. There was not the slightest accident. Not a single horse shied throughout the entire route. Whenever there was an impediment, the driver, directed by M. Phillipart, the manager of the company, who was ever on the alert, had no difficulty in bringing the vehicle to a standstill at a second's notice. The ease with which the car was turned off one set of tram lines and got on to another, across several yards of unmetalled ground, was likewise admirable.

The locomotion is effected by means of Faure accumulators, weighing some fifty hundredweight, which are fixed under the tramway seats, and connected with a Siemens' machine placed under the floor. The machine, which makes 1,200 revolutions a minute, sets in movement, by means of a pulley, an axle, to which are connected the chains which give impulse to the wheels. These wheels revolve sixty times to twelve thousand revolutions of the machine. The speed of the electric tramcar is nine and a third miles an hour on level ground, and five and a half miles on an ascent. The present tram lines are not well adapted for the new locomotion. On the newer lines the movement was sufficiently smooth, but on those that have been laid for some time there was a marked difference, and the actual working force was considerably lower than the indicated horse-power. The experiment, however, says the correspondent of the London *Standard*—the first ever made over a long distance—fully proves the practicability of electric tramcars, and it may safely be predicted that before long they will take possession of the tram routes of the French capital. The estimated cost is one-half that of horse trams.

SPARKS.

—— The electric light is more widely used in American than in foreign industrial establishments.

—— "The interpredity of ignorance," causes the boss lineman on lighting circuit, to refer to electricity as "the juice."

—— A rival of the moon.—The electric-arc light of 10,000 candle-power, which is suspended in front of *The Philadelphia Record* building, ninety feet above the Chestnut St. sidewalk, is said—by *The Record*—to be the most powerful single light in the country.

—— In the Factory Mutual Insurance Companies of New England, there are 856 establishments, whose valuation is nearly four hundred million dollars. 98 of these mills, or eleven and one-half per cent., use electric lights; the total number being 2,636 arc and 11,604 incandescent lamps.

—— My son, you may invent a new electric light, you may improve the telephone until it can be talked to, you may even revise the tariff to satisfy both parties, you may write a dozen books, you may save a sinking State, you may make your name famous, your house great and your memory blessed, and then you will not have as big a funeral as Tom Thumb, who never did anything in his life except to grow less in fifty years than most boys grow in ten. And he only did that because he could not help it.—*Burlington Hawkeye.*

—— A correspondent of London *Electrician*, gives the following as an instant remedy for toothache: With a small piece of zinc and a bit of silver (any silver coin will do), the zinc placed on one side of the afflicted gum, and the silver on the other, by bringing the edges together, the small current of electricity generated, immediately and painlessly stops the toothache.

—— Mr. C. F. Varley, F.R.S., an eminent English electrician, died Sept. 1st. Mr. Varley, as the electrician of the Electric and International Telegraph Company, was the first to successfully lay a cable across the Atlantic. He also patented many useful inventions, one of these being a musical telephone, which he produced in 1870, and which was played on at the Queen's Theatre, in England, in February, 1877.

—— MM. Tissandier have completed the construction of their apparatus, for preparing hydrogen by a continuous process, for filling large balloons. It was tried with a balloon of 300 cubic metres, which conveyed the two brothers to some distance from Paris. This system is a simplification of the apparatus which was used by M. Giffard in his large captive balloon. It will be used for filling the electric balloon now being built by MM. Tissandier.

—— Bonanza Mackey is delighted with the work of his new company. It appears that two operators upon the compound wire of the postal telegraph have recently been sending and receiving 542 messages in three hours, or at the rate of ninety messages an hour. The best transmission upon the ordinary wire is understood to be only seventy-five messages an hour between New York and Boston, which is less than one-third the distance to Chicago.

—— Dr. Haensel, a savant, of Reichenberg, Germany, has succeeded after many experiments, in photographing several flashes of lightning. The photographs took in part of the landscape, and made it possible to estimate with accuracy the locality where the lightning struck. It also proved possible to compute the length of the course traversed by the electric current. These experiments are to be continued with the aid of stereoscopy. They have awakened much interest.

—— The attention of the Senate Committee on Labor was called to the fact that there is at least one profession that is not yet crowded – that of electrical engineering. It is doubtless true that the rapid advances made in the last few years in applying electricity to practical purposes have not allowed the supply of trained electricians to keep pace with them. But there is in this country no special school devoted to the study of this science, and the telephone, electrical light and railway have rendered such a school advisable, if not essential. Here is an opportunity for some of the large universities, where there is even now much good work in this line being done. The unsolved mystery regarding the real nature of electricity and the dangers incident to management of the fluid, offer a wide field for special training. This would be a proper task for a university to undertake, and as the uses of electricity are extended, the field to be occupied will become wider. Besides, much credit would redound to the institutions themselves through the inventions and improvements made by the students.—*Herald.*

—— A trial of the simple but important system of signalizing by electricity was recently made on the Ninth Avenue elevated road, between Fiftieth Street and Rector Street, this part of the road having been equipped with the apparatus to keep trains 500 feet distant from each other. Each locomotive carries a small dynamo machine, wound for electro-motive force, and the current is continually flowing, making a closed electric circuit as a basis of operation. The trial proved perfectly satisfactory. Two locomotives provided with the signal apparatus were placed on the track. The foremost one, in stopping on the 500-feet circuit, automatically started the signal, which instantly set a bell ringing in the cab of the locomotive 500 feet in the rear. Nor would this bell stop ringing until the locomotive ahead moved on and got out of the circuit The stopping of the bell is the signal that no obstruction is ahead. The trial demonstrated that unless both engine drivers are dead, or wilfully negligent, a collision is almost impossible. The great simplicity of the invention, and the comparatively small expense, seem to indicate its general adoption on all railways. Had this system of signals on the elevated road been in existence on the New York Central Railroad, the tunnel horror would never have occurred.

—— TWO COLORED MEN began digging a well, recently, in the yard of an electric light company in Philadelphia. The ground became warmer as they descended, and at a depth of twenty-four feet boiling water poured in and drove them out. About thirty feet distant is an old well into which the hot water from large boilers has been blown, and it is believed that this hot water has so heated the surrounding gravel and sand, that all the water filtering through it is heated to the boiling point.

——A DESPATCH FROM ST. PAUL, MINN., states, that the success with which Supt. Greene of the Northern Pacific telegraphic service carried out his idea of having the strokes of Villard's sledge at the last spike ceremonies heard in this and other cities, is the topic of conversation. An unbroken circuit was effected between Gold Spike, 60 miles west of Helena, and New York, a total distance of 2,595 miles. The wire was cut at the scene of the ceremonies, 1,215 miles west of St. Paul. One end of the wire was affixed to the silver sledge hammer, and the other to the golden spike, and when the first blow was struck a circuit was completed. In this city a cannon was placed in Smith's Park, and all connections made with wires that were to give the signal of the driving of the golden spike. Experiments had previously been made, and it was found that the electric current would explode a dynamite cartridge and powder, and also that it would instantly heat a platinum wire to a white heat. Upon the conclusion of the experiments, a platinum wire was inserted in the vent of the cannon, and everything was in readiness to fire the cannon the instant the signal was received from the point of connection. At 6:18 P. M. the first tick was heard on the instrument, which was switched into connection with the cannon. In less than two seconds the cannon was fired, the bells were ringing and whistles blowing. The subsequent strokes of the hammer were patiently waited for, but they did not arrive. During the interval of striking the first and second blows, a stroke of lightning shattered one of the poles just beyond Billings, and all the wires were rendered useless.

BUSINESS NOTICES.

E. & F. N. SPON have just issued a biographical sketch of Philipp Reis, inventor of the telephone. With documentary testimony, translations of the original papers of the inventor and contemporary publications. The volume is compiled by Sylvanus P. Thompson, Professor of Experimental Physics in University College, Bristol, who says in concluding the sketch "If mere mechanical imperfections do not make an invention any the less a true invention, it would be dishonest to deny to Philipp Reis the honor of the invention, of which he openly stated the successes and the imperfections." The volume is illustrated by explanatory engravings showing the original Reis telephones with all their details of construction. Copies of above, price $3.00, as well as any of the latest books on electricity, can be obtained at 35 Murray Street, New York, or will be sent free by mail on receipt of price.

BUSINESS ADDRESSES.

Bahr & Zahn, Manufacturers of Electrical and Telegraph Instruments, Battery Supplies, 108 Liberty Street, New York.

Bradford, C., Solicitor of American and Foreign Patents, 16 & 18 Hubbard Block, corner Washington and Meridian Streets, Indianapolis, Ind.

Burnap, W. H., Davis & Kidder's Electric Machines, 259 West 27th Street, New York.

Dow, George Q., Telegraph and Telephone Poles; Pins and Brackets, painted and plain, North Epping, N. H.

Fairman, James F., Telephone, Telegraph, and Electric Light Supplies, and Apparatus, Inventor's Institute, Cooper Union, New York City.

Pearce & Jones, Telegraph and Electrical Instruments and Supplies, 64 & 66 John Street, New York.

Pride, Fraleigh & Kyle, Telegraph and Telephone Line Constructors, 23 & 25 Dey St., N. Y.

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BOOK NOTICES.

PHILIPP REIS: INVENTOR OF THE TELEPHONE. A biographical sketch, with documentary testimony, translations of the original papers of the inventor, and contemporary publications. By Silvanus P. Thompson, B.A., professor of experimental physics in University College, Bristol. Illustrated by 3 plates and 48 engravings. 8vo. Cloth. Price $3.00, free by mail. Published by E. & F. N. Spon, 35 Murray and 60 Church Streets, New York. For extended notice of this valuable work see September number of this paper.

THE September number of *Patents on Inventions*, the quarterly review published by Messrs. Burke, Fraser & Connett, for their clients, contains an article on the new patents act of Great Britain, which was passed August 25th, pointing out the differences between the new and the old law, and also a concise abstract of the new law, which covers apparently all that the inventor or patentee will need to know about it, and has the merit of being free from legal phraseology. There is also an abridgement of the new English trade-mark law, and a description of the British Patent Office in London. The other articles are on "Patents in Austria," "Peculiarities of the Patent System," and "A Canadian Patent Decision."

ELECTRICITY AND ITS USES; by J. Munro. Religious Tract Society: London 180 pp. 12mo.

This book is a contribution to the literature of the subject on behalf of the general reader, and it treats in a rapid manner nearly all of the principal uses of electricity up to the present time, and occasionally digresses into discounting the future.

The illustrations of the work are good, being those which have done service in *Engineering*, and its contemporaries, and the circulars of the various lighting companies.

The well known view of the carbons forming the arc light, which was first used to illustrate the report of the investigations of the select committee of the Franklin Institute, is used (Fig. 58), but, unfortunately, wrong side up. We also notice that incandescent lamps are used (Fig. 72) to illustrate the position of lamps in series, on a circuit. If the writer in his careful attention to circulars of various patentees has been led into certain extremes of statement, it is equally true that he has noted some of the latest products of electrical invention.

The book is certainly to be commended to those who desire to be informed, in a general way, relative to the status of electrical devices, and it is more correct than is usually the case with attempts to popularize science.

A PRACTICAL TREATISE ON LIGHTNING PROTECTION; by Henry W. Spang. D. Van Nostrand. 63 pp. 12mo.

This useful volume embodies the result of over twenty years' experience on protection against lightning, and we believe it to be the first book ever published upon this subject. The system of conductors recommended by the author consists in erecting pointed iron rods, extending above chimneys and other elevated portions of a building in the usual manner; below this point, instead of leading the lightning rods over the roof and to the ground, the author very ingeniously avails himself of the immense conducting capacity of metal roof coverings, or of plates of sheet metal extending along the ridge and to the gutter at each end, and also diagonally on the roof. The metal water conductors are also used as electric conductors, but the most valuable feature of the whole matter seems to be his device of obtaining ground connections for the system. It is well known that a good ground is essential for an efficient lightning rod, and that in the dry earth near buildings, this is seldom reached near the surface.

An extension of the water conductor with perforations, is driven into the earth to a suitable distance, and when the shower begins the water is at once conducted to this tube, and is disseminated through the earth by means of these orifices, thereby providing a large mass of damp earth. The writer very clearly shows the fallacy of relying upon the small rods in general use, and very clearly states the error in assuming that glass insulators carrying a rod a few inches from a building will conduct an electric current, whose potential is sufficient to leap through 3,000 feet of air, if the conductors and their ground terminals are not of adequate capacity. We note in this connection an evident oversight—middle of page 50—where "a few feet of air" should be "a few *inches* of air."

The book contains useful tables of the weight per foot of iron plate and pipes of different brands, suitable for conductors.

Among many useful and scarcely known matters, the author calls attention to the fact that an adequate system of lightning conductors is constantly conducting the electricity in the lower strata of the atmosphere to the earth, and thus always tending to establish an electrical equilibrium.

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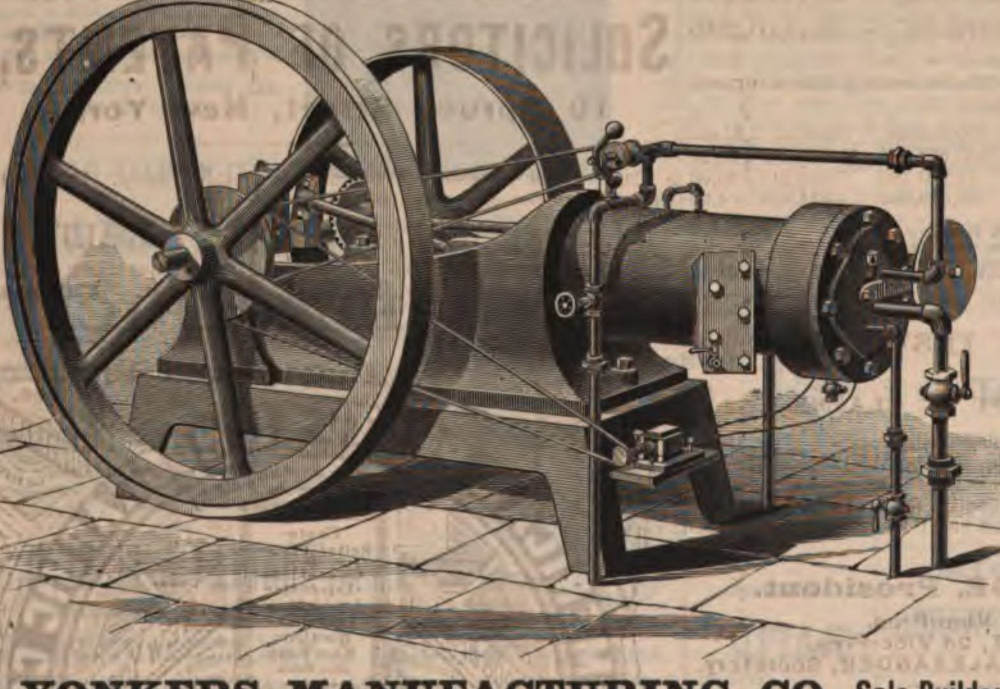

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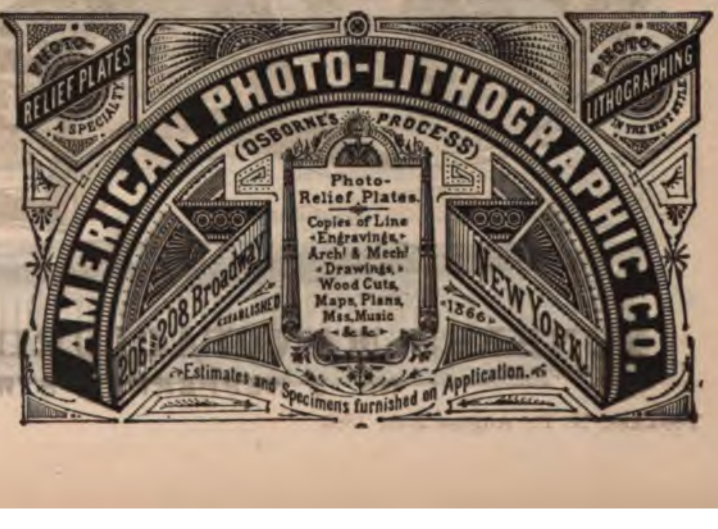

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PATENTS FOR AUGUST AND SEPTEMBER, 1883.

AUGUST 28th.

284,137	Cables, Testing Lead covered. W. I. McElroy, Pittsburg, Pa.
284,094	Cables, Testing Lead-covered. H. Van Hoevenberg, Elizabeth, N. J.
283,763	Electric Cable. T. B. Delany, New York, N. Y.
284,100	Electric Cable, Truck for paying off. R. S. Waring, Pittsburg, Pa.
284,099	Electric Cables, Joint Connection in Lead-covered. R. S. Waring, Pittsburg, Pa.
284,138	Electric Cables, Testing. W. J. McElroy, Pittsburg, Pa.
284,139	Electric Cables, Testing Box for Underground. W. J. McElroy, Pittsburg, Pa.
283,748	Electric Lights, Automatic Cut-out for. A. Bernstein, Boston, Mass.
284,110	Electric Machine, Dynamo. K. Zipernowsky, and M. Dére, Buda-Pesth, Austria, Hungary.
283,807	Electric Wires, Underground Conduit for. E. Omensetter, Philadelphia, Pa.
283,764	Electrical Conductor. T. B. Delany, New York, N. Y.
283,983	Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
283,984	Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
283,985	Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
283,986	Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
283,759	Locomotive, Electric. L. Daft, Greenville, N. J.
283,761	Locomotive, Electric. L. Daft, Greenville, N. J.
283,760	Railway Rail, Electric. L. Daft, Greenville, N. J.
284,031	Telegraph and Telephone Lines, Combined Cut-out and Ground Switch for. C. H. Lothrop, Lyons, Iowa.
283,995	Telegraph, Duplex and Quadruplex. G. W. Gardanier, New York, N. Y.
283,944	Telegraph Fire Alarm. T. Ahearn, Ottawa, Ontario.
284,102	Telephone and Signal Circuit. E. P. Warner, Chicago, Ill.
284,003	Telephone and Telegraph Lines, Signaling Apparatus for. E. Gray, and F. L. Pope, Elizabeth, N. J.
283,927	Telephone Call Boxes, Circuit for. C. E. Scribner, Chicago, Ill.
283,806	Telephone Exchange. I. M. O'Donel, Pittsburg, Pa.
283,747	Telephonic Apparatus. W. A. Belcher, Lowell, Mass.

SEPTEMBER 4th.

284,365	Car Wheel and Brake, Electro-magnetic. H. M. Beidler, Texarkana, Ark.
284,578	Clock, Primary Electric. D. F. Sweet, Hastings, Mich.
284,355	Clocks, Circuit for Secondary Electric. H. L. Bailey, Brooklyn, N. Y.
284,348	Electric Call and Signal. L. J. White, Waterbury, Conn.
284,423	Electric Conductor, Compound. W. B. Hollingshead, New York, N. Y.
284,247	Electric Light Stations, Switch Board for. R. J. Sheehy, New York, N.Y.
284,420	Electric Lighting. K. W. Hedges, Westminster, England.
284,357	Electric Machine, Dynamo. C. E. Ball, Philadelphia, Pa.
284,277	Electric Machine, Dynamo. W. B. Cleveland, Cleveland, Ohio.
284,277	Electric Machine, Dynamo. W. B. F. Elphinstone, and C. W. Vincent, Holloway, England.
284,292	Electric Machine, Dynamo. J. E. H. Gordon, Gordon, England.
284,255	Electric Motor. L. W. Stockwell, Cleveland, Ohio.
284,413	Electric Wire Conduit. L. M. Green, and I. P. Birch, Philadelphia, Pa.
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284,498	Telegraphy. G. Smith, and T. F. Taylor, Brooklyn, N. Y.
284,425	Telephone and Telegraph Cable. C. Huck, New Orleans, La.
284,426	Telephone and Telegraph Cable. C. Huck, New Orleans, La.

SEPTEMBER 11th.

284,878	Annunciator, Electrical. D. A. McCormick, Detroit, Mich.
284,980	Burglar Alarm. W. H. Reiff, Philadelphia, Pa.
284,840	Double Circuit Instrument. A. W. Hall, Meriden, Conn.
284,605	Electric Battery. H. A. Burns, Ansonia, Conn.
284,854	Electric Conductor, Underground. I. B. Hyde, New York, N. Y.
284,842	Electric Conductors, Apparatus for Interlocking. A. W. Hall, Meriden, Conn,
284,841	Electric Switch and Signal Apparatus. A. W. Hall, Meriden, Conn.
284,715	Electric Switch or Circuit Controller. A. Bernstein, Boston, Mass.
284,959	Electric Wire. W. Halkyard, Providence, R. I.
284,714	Electric Wires, Safety Device for. A. Bernstein, Boston, Mass.
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285,327	Electric Cable Support or Hanger. A. J. Weaver, Providence, R. I.
284,999	Electric Machine, Dynamo. A. Bernstein, Boston, Mass.
285,249	Electric Machine, Dynamo, F. K. Fitch, New York, N. Y.
285,097	Electric Machine, Dynamo. I. Gray, Medford, Mass.
285,088	Electric Time Signaling Device. H. G. Van Wagenen, Monroe, Wis.
285,066	Galvanic Battery. F. H. Peckham, Jr., Providence, R. I.
285,267	Insulation of Electrical Conductors. W. J. How, Philadelphia, Pa.
285,008	Photographer's Retouching Point. J. T. Burke, Nebraska City, Neb.
285,076	Telegraph, Fire Alarm. E. Rogers, Brookline, Mass.
285,245	Telephone Exchange System. J. E. Fenn, Elizabeth, N. J.
285,342	Telephone Exchange System, Signaling Apparatus for. J. H. Cary, Boston, Mass.
285,004	Telephone, Mechanical. W. J. Bowen, Norwalk, Ohio.
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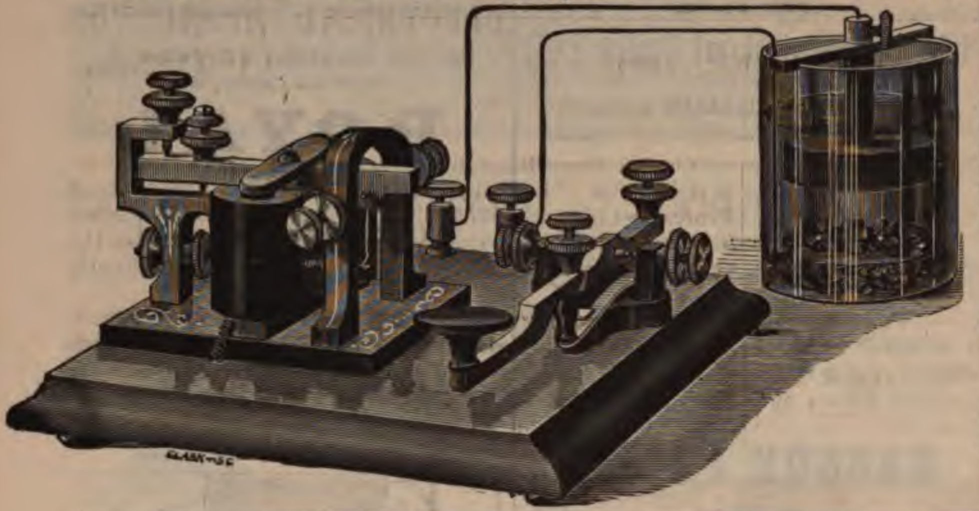

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THE SUN LAMP.

ANYONE who has ever written or read at night much, must often have desired a steady, clear, and soft light. Gas does not give it, and the candle requires too much attention, while the red rays of the petroleum light are objectionable. If we can believe reports from abroad, the coming light for the reading room and the workshop should be the new "Sun Lamp," which is an improvement of the *lampe soleil*, a French translation of the same words, which, though expressive, is liable to lead to confusion in the future. The great improvements consist in having a fixed position of the carbon rods. These rods are very short, and are placed on each side of a block of marble, which is thus rendered incandescent. Fig. 1 is a general view of the lamp. Fig. 2 shows the arrangement. The two rods approach each other very nearly, but a hole in one of them allows the passage of another rod, that makes contact with the solid rod, and forms an arc. The carbon rods are pressed forward by means of springs according as consumed, and which same springs form short circuits when the carbons have reached the end. A safety switch is mounted on the lamp bracket, allowing the current to pass —one portion along the German silver resistance coils, with two mercury cups, connected by a metal fork; another portion of the current crosses the main circuit, then along the hollow carbon rod, and across the end of the small carbon rod, to the other, and thence to line. Fig. 3 shows main circuit, together with the mercury cups. Fig. 4 represents carbon rods, and the pencil that passes through the hollow one for igniting, which is done by various means. The brilliancy of the light is suitably tempered by having the lamps surrounded by opal globes, while the light itself, when required for reading purposes, etc., is inverted, and is thus reflected from the walls and ceiling, adding most powerfully to the general comfort and effect.

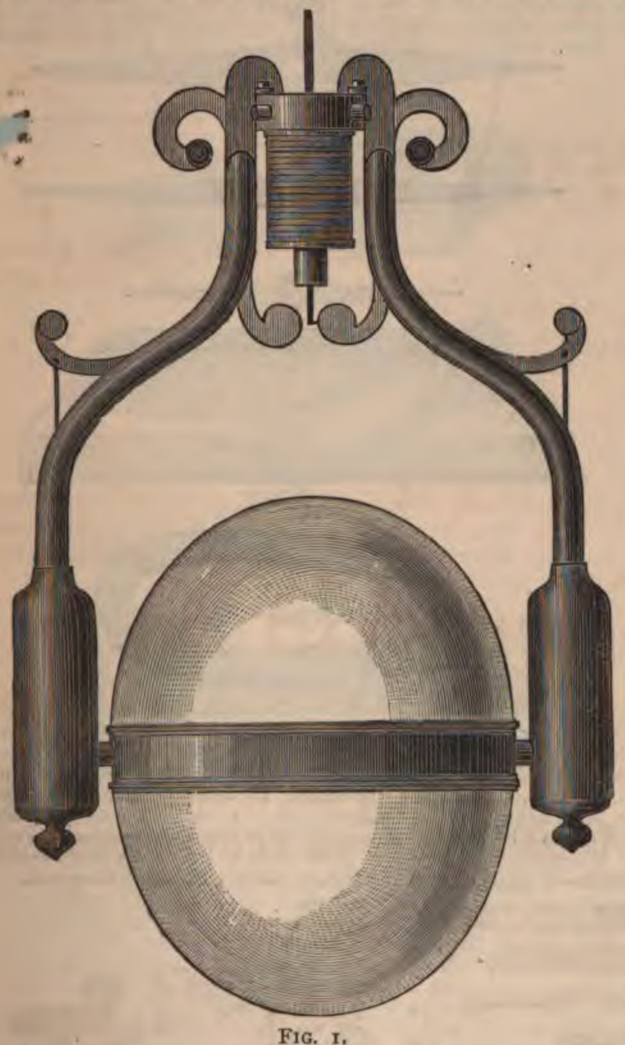


FIG. 1.

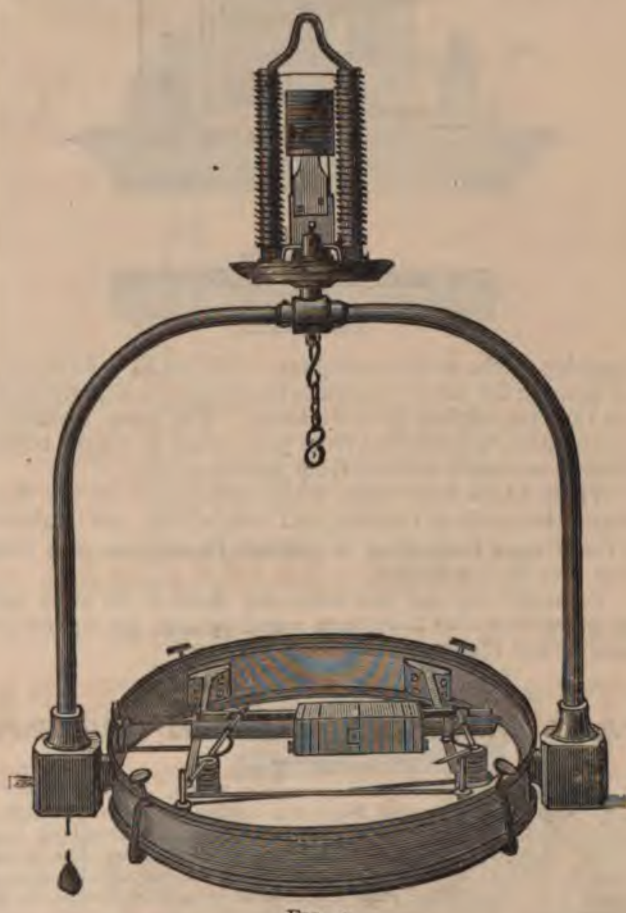


FIG. 2.

The marble of the sun lamp lasts from fifteen to fifty hours, according to the current used. For the 1000-candle lamp it lasts about thirty hours. The cost to the company of each marble is 3d., and the cost in carbon consumption is about the same as that of the marble. It is said that almost any kind of common white marble will answer. The carbonic acid is rapidly burnt out after the lamp is kindled, and the stone becomes harder and more resistant after this expulsion of the acid is complete. The small hole forming the passage for the arc becomes burnt out to a slightly larger size than its original ¼in. diameter. The lamp is made in various sizes, arcs varying from ½in. to 4in. in length, corresponding to candle powers from 500 to 50,000.

FIG. 3.

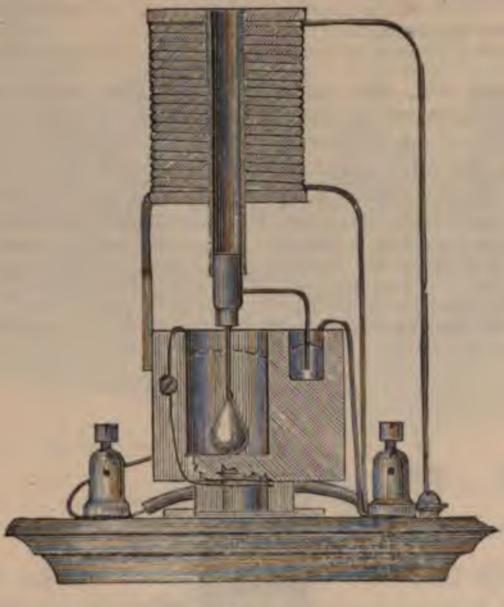
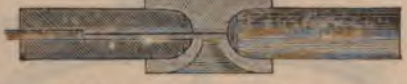


FIG. 4.



These lamps have been lately introduced in the Kensington Museum in London, and one of the Art Galleries at the Vienna Exhibition is lighted by them in the latest form they have assumed.

Perhaps some day this lamp may serve to do away with the objections that have been urged against the opening of some of our libraries at night in this city.

THE DYNAMO: HOW MADE AND HOW USED.

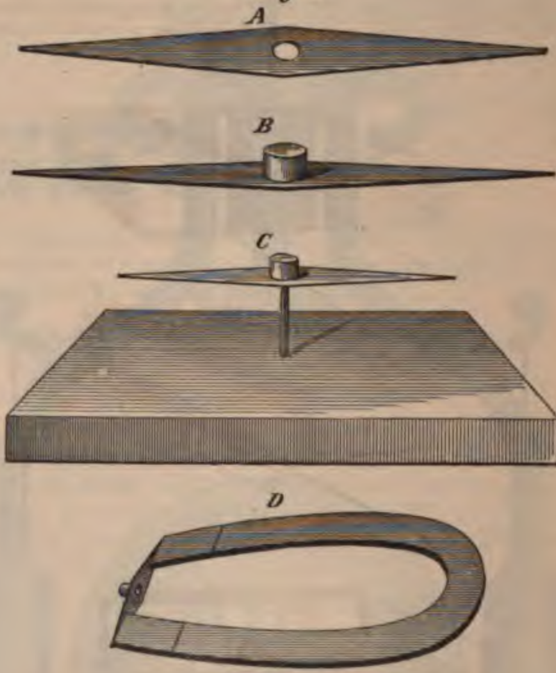
NUMEROUS inquiries have appeared in "ours," says Mr. Selimo R. Bottome in *English Mechanic*, respecting the construction of dynamo-electric machines, and replies equally numerous have been forthcoming But very few of those who have turned their hands to the construction of small dynamos appear to have been successful in their attempts, if we are to judge from the tenor of the greater part of the correspondence. Now the construction of a small dynamo presents no greater difficulties than that of an induction coil wound with an equal weight of wire, provided precautions be taken to insure thorough insulation, and due regard be paid to the correct proportioning of the size of wires coiled round the field magnets and the armature, of one another and to the mass of metal employed, as well as to the nature of the work to which it is intended to put the dynamo when completed.

In the following papers I shall confine myself exclusively to the *hand dynamo*, as being more within the reach of our amateurs, whether regarded from the point of facility of construction, or of not requiring steam or other engines to set it in action.

§ 1. *What a Dynamo Is.*—As understood at present, the dynamo-electric machine may be defined as a machine whereby energy (motion) is converted into electricity by the aid of the residual magnetism present in certain iron portions; which electricity is caused to react on the iron and so heighten its magnetism; and this increased magnetism in its turn gives rise to more powerful electrical effects, and so, until its limit is reached, depending partly on the velocity of the motion, partly upon the relative apportionments of the size and quantity of the wire and iron employed in its construction, and partly on the resistance throughout the circuit. Although this principle was fully understood, and described by Soren Hjorth, of Copenhagen, in his patents, dated October, 1854, and April, 1855, yet the name "dynamo" (from *dynamis*, Gr., *force*) does not appear to have been used in this connection, until Dr. Werner Siemens employed it in a communication to the Berlin Academy, January 17, 1867.

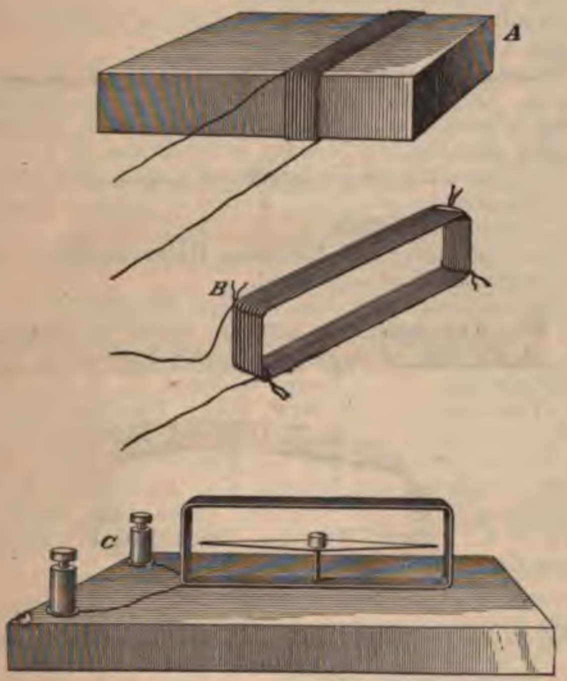
§ 2. *Faraday's Discovery.*—The closeness of the relationship between the phenomena, which we call *electricity* and *magnetism*, had struck many philosophers of the eighteenth century. Oersted, of Copenhagen, in 1819, was the first to prove, by a series of masterly experiments, the magnetic properties of current electricity; Ampére, and Arago in France, and Sir Humphrey Davy in England, then distinguished themselves by their zeal and activity in this research; but the keystone of the arch was laid when Faraday, in November, 1831, showed that it was possible to call forth electric currents by means of a magnet. In order that the reader should have an intelligent knowledge of the principles which underlie the construction of the dynamo, it would be well for him to repeat some of the experiments about to be described, more especially as they are easy of performance and trifling in cost.

Fig. 1.



The first thing required will be a *galvanometer*, an instrument for indicating the presence of current electricity (and in some cases to measure its quantity). To make this, a piece of crinoline steel, 2 in. long and ⅛ in. in width, is "softened" by heating the middle portion over a gas jet or other flame until red hot, then allowed to cool *gradually*. By laying this across a knife blade the exact centre is found and *marked* By means of a screw-drill a hole about $\frac{3}{32}$in diameter clear through the centre of this steel "needle," as it is called, is bored. By filing from the centre towards the side the needle is brought to the shape of a lozenge, as seen at Fig. 1, *A*. Holding this needle by means of a piece of copper wire passed through the hole, it is heated to dull redness over a flame and plunged into cold water to restore its temper. A piece of brass rod, ⅛in. in diameter, and about ⅛in. long, is now soldered centrally, just over the hole. This is easily done by cleaning the needle with a bit of sand-paper, specially round the hole, cleaning also the little piece of brass rod, on its end, then putting a little piece (as big as a grain of mustard seed) of plumbers' solder just over the hole bored in the needle. Holding the needle with a pair of forceps (a little rosin powder having been previously applied round about the hole) over the flame of a spirit lamp or gas burner, will cause the solder to melt and adhere to the steel The piece of brass is now taken up with another pair of forceps and laid (flat side downwards) as centrally as possible over the hole. Keeping the needle still over the flame, the solder will also flow round the brass and adhere to it, making a firm junction when it may be removed from the flame and placed *at once* on a cold metal or stone surface. It should now present the appearance shown at Fig. 1, *B*. Any solder which may have exuded from between the brass and the steel should be filed away. Using the same bit in the screw drill that was employed originally to bore the hole through the steel, a conical hole, reaching nearly but not quite to the opposite surface of the brass piece, is drilled from the hole in the steel. This serves as a pivot on which to poise the needle. A trial may now be made to find whether the needle is fairly centered, but no attempt need be made *yet* to balance it if not true. Having cut off the head of a fine pointed pin, let us drive it, blunt end downwards, into the centre of a little slab of well seasoned pine 3in. by 3in. by ½in., leaving not less than ¾in. protruding. On the point we can poise the needle, and *mark* with a pencil the end which hangs (if either does). Fig 1, *C*, will show what is meant. The needle must now be *magnetized* by being allowed to remain for some time (twenty minutes or half an hour) across, and in contact with the poles of a horse-shoe magnet, care being taken that having once placed the needle in one position it should not be reversed, as its polarity would be reversed if this were done; and since in our latitude the *North seeking pole of a freely suspended needle hangs downwards*, if the needle, when tried previous to magnetizing, had one end *heavier* than the other, *that* end must be placed against the North pole of the horse-shoe magnet, by which means it will acquire South seeking polarity, and, consequently, neutralize to a certain extent the inclination of the poised needle. After magnetization it should be again poised, any deviation from the horizontal line noted and corrected by cautiously filing the needle on one of its flat sides, at its heavier extremity, with a fine file, until perfect equilibrium is obtained. Fig. 1, *D*, illustrates the position in which the needle should be placed with relation to the magnet during magnetization. When the needle has been well balanced it ought to turn very freely on its pivot, making several free swings, but finally taking up a position pointing *North* and *South*. It should also show decided polarity when tested with a magnet, that is to say, one extremity should be strongly *attracted*, and the other just as *strongly* repelled on the approach of the North pole of a horse-shoe or bar magnet. When all these conditions have been satisfied, it will be well to mark with a pencil the letter *N* on the extremity of the needle, which is *repelled* by the North seeking (or marked) end of the magnet. This extremity will be the *North seeking end* of the needle, and is generally (though inaccurately) called its *North pole*.

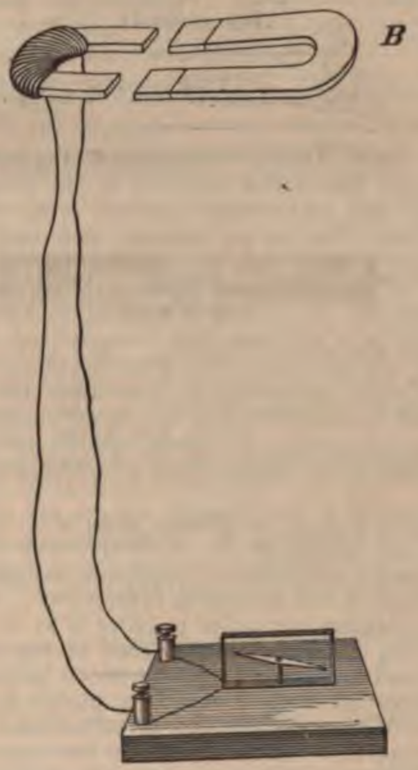
Fig. 2.



§ 3. We have now succeeded in making and poising a magnetic needle. In so doing we have learnt two important facts: (*a*) that *steel* becomes permanently magnetic when placed in proximity to a magnet; (*b*) that each pole of the new magnet thus formed evinces a polarity of opposite kind to that possessed by the pole of the original magnet which induced its magnetic condition:—in other words, the *North* pole of the original magnet induces *South* polarity in that portion of the steel nearest to it, while the *South* pole induces *North* polarity.

Our next step is to surround the needle with a coil of insulated copper wire. To this end a piece of wood 2½ in. wide by 1½ in. thick, and of convenient length to hold in the hand, is prepared as a form, the edges being slightly rounded to admit of the wire being slipped off; this is then wound with about 10 ft. of No. 30 silk-covered copper wire, as shown at Fig. 2, *A*, leaving about 3 in. of wire projecting at each extremity. The four corners of the rectangle thus formed should be bound with silk, so as to prevent uncoiling when the rectangle is drawn off the wooden form. The coil, on removal from the form, should present the appearance shown at *B*, in which the ends of the silk, used to tie the corners, are purposely exaggerated in length, the better to show their position. The centre of the coil being found, the wires forming one of the flat sides are slightly parted by means of a blunt pin (care being taken not to abrade the silken covering), and the coil passed over the pin point fastened in the centre of the little baseboard above described § 2, and attached thereto with a little dab of hot sealing-wax, or better still, with Prout's elastic cement. The needle is then replaced, and tried, to see whether it oscillates freely without catching at any point in the coil. The two free ends of the wire are now to be denuded of their silk covering, cleaned with a bit of sand or glass paper, and attached to two small binding screws (those known as telephone binding screws, and sold at most electricians at 1s. 6d. per dozen, will do admirably), inserted one at each corner of the base board. The galvanometer or *multiplier* is now complete, and should appear as figured at *C*. When all is in position, note from which binding screw starts the wire which goes *over* the needle. Mark this binding screw by writing "over" near it. The galvanometer is used to detect the presence of current electricity by causing any such current to pass through the coils of the instrument. For this purpose the two opposite extremities of any circuit, through which it is supposed a current is flowing, are each connected to one of the binding screws. If a current passes the needle (which previously must be made to lie parallel with the coil, by turning the base board round until the coil points North and South, like the needle), will immediately start out from its position of parallelism with the coil, and take up a position which will approach nearer to right angles with the coil, in proportion as the current is stronger. To test whether the galvanometer just made be fairly delicate, attach a piece of copper wire about 1-32 in. thick and 6 in. long to one of the binding screws; to the other attach a similar piece of iron wire. Now, bring the free ends of the wire (by bending) within ⅛ in. of each other. Turn the base board round until the North end of the needle points between the two binding screws, perfectly parallel to the coil. Put a single drop of vinegar on a little piece of glass, and bring it under the two ends of the wires, which must be lowered until they are both *in* the drop of vinegar, but do not touch each other. By the action of the vinegar on the two metals, an electrical disturbance is set up, which produces a so-called "current" which starts from the iron, passes through the vinegar, along the copper wire, through the coils of the galvanometer, and back again into the iron, this action being continuous as long as the vinegar acts on the iron. Simultaneously with this, the needle is seen to deflect from the line of the coil, and if our galvanometer is a success, it should stand out at least 20° from the central line of the coil. Faraday's great discovery, on which all dynamos are based, consisted in proving that a magnet could be caused to excite a current, similar to that produced by the action of acids on metals. We can now repeat his experiment with

Fig. 3.



the aid of our galvanometer. Let *A*, Fig. 3, be a rod of ¼ in. soft iron, about 6 in. long, bent to the shape of the letter U, and wound round its central portion with about 100 ft. of No. 24 cotton-covered copper wire, the two ends of which (about a yard each end) having been stripped of their covering, must be attached to the binding screws of the galvanometer. If a good horse-shoe magnet, *B*, be placed in contact with the two legs of the coiled U, this latter being kept motionless, while the magnet is alternately approached to and separated from it, it will be found that the needle of the galvanometer is powerfully affected, first in one sense and then in the other, according to whether we *make* or *break* contact with the U, or *armature*, as it is called. We shall also find that, although the most powerful effects are noticed when actual contact and actual separation take place, yet currents are also produced on approaching or removing the magnet to or from a distance. In other words, *motion in the field of a magnet gives rise to electricity*. A contributor to *Blackwood's Magazine* embodied this fact in the following lines:

> Around the magnet, Faraday
> Is sure that Volta's lightnings play;
> But how to draw them from the wire?
> He took a lesson from the heart;
> 'Tis when we meet, 'tis when we part,
> Breaks forth the electric fire.

If we study the effects thus obtained, we shall find that they differ, in some points very markedly, from those obtained by the action of acids on metals (voltaic electricity—galvanism), inasmuch as, first, the action is *not* continuous; secondly, it is contrary in direction when contact is *made*, to what it is when it is *broken*.

(*To be continued.*)

THE NATIONAL TELEPHONE CONVENTION.

THE Fourth Annual Convention of the National Telephone Association was held in the Gibson House, Cincinnati, Ohio, on October 16th and 17th. The attendance was larger than on any previous year, and all sections of the country were well represented, few of the prominent men in the telephone business being absent. It is evident that the convention is growing in usefulness from the fact that it is well attended by busy men, whose time is valuable and who come from great distances. The social features of these gatherings are noticeable, the time being well divided between business and social amenities. Many pleasant acquaintances are made, and friendships formed and cemented by the opportunities afforded at these gatherings.

The exhibition of telephonic apparatus and supplies generally, has grown to be a conspicuous feature, and forms a special attraction to telephone managers. A list of the exhibitors will be found further on.

The convention was called to order at 11 A. M., October 16th. Acting President J. B. Speed in the Chair. The Secretary read his annual report, in which he recommended that hereafter the dues of members should be levied *pro rata*, according to the number of subscribers in the exchanges which they represent. There has been no increase in the membership of the association during the past year, a fact which was attributed to the numerous consolidations which had taken place. A salary of $300 was voted to the retiring Secretary for services during the past year. The Treasurer's report stated that the receipts for the year were $1,721.40; expenses $743.67, and cash on hand $977.73.

An election for officers for the ensuing year was then held, which resulted as follows: President, Morris F. Tyler; Vice-President, Wm. H. Eckert; Secretary, C. N. Fay; Treasurer, F. G. Beach. Executive Committee: Morris F. Tyler, W. A. Jackson, H. L. Storke, A. D. Bullock and Henry Metzger. Mr. H. B. Lytle was elected a member of the Advisory Committee, to serve three years.

The Executive Committee made a special report on the death of the late President of the Association, ex-Gov. Marshall Jewell, who died in February last. Appropriate remarks were made by ex-Gov. Howard and Mr. Tyler.

The convention then adjourned till the afternoon. At the afternoon session an invitation was received from the officers of the Cincinnati Exchange for the members to visit the Exchange and other points of interest in and around the city. The resignations of all members whose exchanges had been consolidated were accepted *pro formâ*, although none had been actually tendered. The Committee on Legislation reported a gratifying decrease of litigation among the exchanges, and attributed that fact to the vigilance and care of the American Bell Co. It was stated that in many states telephone companies now possessed the same legal standing as railroad and telegraph companies, and could condemn property on the same conditions as those corporations. The Committee on Statistics presented a detailed report of the number of subscribers, number of wires direct, circuit and trunk, proportion of subscribers to population, average calls per day, number of operators, the rates charged per year, and proportion of operators to wires, for each exchange in the country. The report is too long for insertion here. It is a very valuable and instructive document, and we may find space for it in a future issue.

The Committee on Supplies and Appliances made no report.

Messrs. O. E. Madden and Thomas D. Lockwood were elected to honorary membership.

An adjournment was then taken till 10 A. M. the following day, October 17th.

Second Day.—The convention was called to order at 11 A. M. On motion of ex-Gov. Howard, the convention agreed to meet next year in Providence, R. I., on the first Tuesday after the first Monday in September.

The Committee on Underground Cables then reported on cables used for telephone service in Chicago, San Francisco, London, and Paris.

The Committee on Exchange Rates made no report. The convention then adjourned.

The exhibitors were the Western Electric Co. of Chicago, Ill.; The American Electric Works of Providence, R. I.; A. G. Day, of Seymour, Conn.; Partrick & Carter, of Philadelphia, Pa.; Charles Williams, Jr., Boston, Mass.; Law Telegraph Co. of New York; Standard Electrical Works, Cincinnati, O.; E. T. Gilliland, Indianapolis, Ind.; The Stabler Individual Bell Co., Washington, D. C.; Rhode Island Telephone and Electric Co., Providence, R. I.; J. A. Roebling's Sons, of Trenton; Utica Fire Alarm Co., Utica, N. Y.; Palmer Wire Co., Palmer, Mass.; Electrical Supply Co. of New York.

SLEEPING WITH THE HEAD NORTHWARDS.

M. G. DE ROCQUIGNY writes as follows to the editor of *Les Mondes* on the above subject:—" M. C. Vignier wrote as follows in the *Révue Philosophique* for 1882, No. 7, July, p. 31: 'Is there, then, an agency capable of exercising a continuous action on the apparata of the nerves (*canaux*), varying with the position of the head? To my mind this agency exists, and is none other than terrestrial magnetism. That an all-pervading force should be without any action on our organism when we see it influenced by the least variation of light and heat, is surprising enough already. But it is beyond dispute that galvanic currents not only exercise a powerful effect on our nervous system, but that electro-magnets themselves produce well marked effects in certain nervous affections. The experiments undertaken at Salpetrière, by M. Charcot, leave no room for doubt on this point; and there must be some foundation for the practice adopted by the Swedish peasants, who cause themselves to be buried for several hours so as to lie North and South in order to cure neuralgia.' To this the author adds the note:—'I have this fact from M. Nordstrom, Swedish Consul at Alger. It is, moreover, sufficiently proved by physiological experiments that a very close relation exists between the nervous system and electricity, of which magnetism is but one form.' In another note the author quotes the following experiment, carried out by M. Ziégler, of which, M. Vogt was a witness:—'M. Ziégler takes a lens of soft iron, he exposes it in a place where it will receive the lines of terrestrial magnetism and redirect them on to the organ to be studied. By thus projecting the magnetic lines concentrated in this manner on the heart of a rabbit, the rhythm of the heart is changed; if the lines are concentrated on the intestines, violent peristaltic movements (*péristaltiques*) are caused (*Journal Officiel*, May 18, 1881). The preceding facts will, perhaps, appear to you, Monsieur l'Abbé, to add some degree of probability to the theory put forward by *The Electrician* of London.'"

THE AMERICAN INSTITUTE FAIR.

THE ELECTRICAL EXHIBITS.

THE number of electrical exhibits is smaller this year than for many years previous, and although what there is of it is excellent in quality, and represents many of the recent applications of electricity, the number of inventors and manufacturers who use this method of reaching their clients has much diminished. The building is still lighted by electricity, this portion of the display being under the control of the United States Illuminating Co. There are eighty Weston arc lights in the building, fed from an ordinary street circuit which is worked from the company's station in Stanton Street. There are in addition 200 Maxim incandescent lights, which are operated by a local installation, the engine and dynamos being all within the building. This portion of the exhibit is under the charge of Mr. M. J. Quinlan, the company's dynamo engineer. An E. P. Hampson engine, of about 30 horse-power, furnishes the power which drives 3 Weston dynamo machines. One of these machines, and the smallest of the three (style No. 6), excites the field magnets of two large 100-light machines. Each of the latter feeds a separate circuit of 100 incandescent lamps; the lamps, each of about 70 ohms resistance, being connected in multiple arc.

Messrs. J. and H. Berge, of 191 Greenwich Street, this city, repeat their exhibit of last year, the most conspicuous feature being their celebrated self-contained Holtz machine. This apparatus is constructed for use in the arts, where high tension electricity is required, and can be arranged to run with a motor driven by any convenient source of power. A machine with six 30-inch plates will produce a 15-inch spark.

The Rousseau Burglar Alarm Company exhibit specimens of all of their specialties, among the most noteworthy being automatic electrical gas lighters, by which the gas may be lighted or extinguished at will at any distance from the burner; the improved burglar alarm having a time keeper which puts the alarm on or off at any desired hours, awakens sleepers by ringing alarm bells in any desired room or rooms at any hour, shunts any portion of the house out of circuit until a certain desired hour is reached, so that a portion of the house is protected while the other portion, which may be used up to a late hour, is not; and in addition is supplied with a key which will enable the possessor to enter and leave the house while the alarm is on without starting the alarm. This company also exhibit a new watch clock for sixteen stations, the signals being sent by simple push buttons; a separate wire and electro-magnet for recording being used for each station. The clock contains an annunciator, which indicates whether any of the sixteen circuits be out of order, and has an arrangement for detaching that circuit from the rest of the system, automatically, so as to prevent the weakening of the battery by remaining on closed circuit. An automatic gas lighting arrangement, exhibited by this company, contains a device for the shunting out of the system any portion of the circuit which is kept on closed circuit for a certain adjustable length of time; a clock-work does this automatically, after a certain time has elapsed, so that the efficiency of the general system shall not be impaired by any interruption to one portion of it. All of these devices, the inventions of Mr. Rousseau, are characterized by great fertility of resource in devising plans for preventing the various interruptions to which this class of apparatus are liable, great mechanical skill in carrying them out, as well as great foresight in preparing for the peculiar difficulties involved in the efficient maintenance of domestic electrical apparatus.

The Jerome Kidder Manufacturing Co., of this city, have a splendid exhibit of electro-medical apparatus. They also display an apparatus for galvano-cautery, consisting of a Bunsen battery, and instrument for applying and holding the platina wire loop to the parts. This old established house needs no commendation for the excellence both of design and manufacture, which render their machines a standard of quality all over the country.

The Galvano-Faradic Manufacturing Co. of this city, also exhibit a fine collection of electro-medical and surgical apparatus. The attention of experimenters with limited means is called to their water rheostat, which is a marvel of cheapness and efficiency. It is to be regretted that neither this company nor the one just mentioned have any of their apparatus in action, nor competent persons in charge to explain them. Apparatus locked up in a glass-case may be very beautiful to look at, but are scarcely so instructive to the observer of enquiring mind as the simplest of the apparatus in operation would be.

Electric motors are represented by but one specimen, exhibited by the Cleveland Electric Co. The motor shown by this company is the invention of Messrs. Sheridan & Gorn, will furnish from 1 to 5 horse-power, and can be driven by a battery or dynamo current where the latter is laid on like gas or water. They can be furnished with a governor if desired. For sewing machines, dentists' drills, etc., a battery of 6 Bunsen cells is furnished, the plates of which can be immersed, to a greater or less extent, within the liquid by a treadle, thus affording a ready means of regulating the speed and power.

The New York Applegate Electric Matting Co. have a large exhibit of their really valuable specialty. This is now adapted to automatic gas lighting, as well as the customary alarm or signal bell ringing. This system has many advantages over the more complicated systems of circuit closers, besides its incontestable superiority on the score of economy.

The electrical department of this year's exhibition is noteworthy for its smallness and for its lack of novelties. To judge of the progress of electricity in the arts by what is displayed here, one would think that discovery and application had stood still during the past year.

It is evident that promoters of electrical applications, requiring large and expensive plants, do not find it worth their while to make any display here. The manufacturers of electrical apparatus whose products are portable, compact, and relatively cheap, are those whose specimens we may expect to find in this exhibition.

Conspicuous by their absence are several recent improvements in our art, which are peculiarly well adapted for this means of display. Among them are the many recent applications of electricity for the distribution of standard time, by driving and regulating clocks, and by time balls, railroad signals, lightning rods, electric elevators and railways, telephones, and the apparatus for using the electric light to explore cavities in the human body.

—— M. TOMMASI HAS DEVISED an arrangement to make the luminous point of the Jablochkoff candle practically stationary. A selenium regulator acts as an automatic elevator of the point as the candle burns down.

INTERESTING AND SUCCESSFUL TESTING.

"PROF R. H. Thurston, the accomplished author and experimenter in the domains both of abstract and practical science, now occupying a chair in Stevens Institute, Hoboken, honored our city with a visit, yesterday, for the purpose of having the Armington & Sims engine tested, under his own personal supervision. The exigencies of electric lighting have imposed on the steam engine, requirements much more arduous and difficult than were formerly contemplated. To meet these requirements, the inventive genius of the world has been stimulated to a marked degree, and results obtained, which, a few years ago, would not have been thought possible of achievement. In view of these new developments, Prof. Thurston has felt it incumbent upon him to supplement his already voluminous teachings with another work specially adapted to the consideration of the present largely enhanced efficiency in steam economy. In accordance with his exact method of relying only on personal observation—with the aid of one of the students of Stevens Institute—he conducted an exhaustive series of experiments Wednesday afternoon, at the rooms of the American Electric and Illuminating Company on Aborn Street. The result was a substantial triumph for the engine experimented with. The severest tests were applied and sustained, the engine doing more even than was ever claimed for it."—*Providence Journal*, Thursday, September 27, 1883.

We clip the above from a very enthusiastic report of the trial of the Armington & Sims engine, which appears in the columns of our contemporary. It is probable that Prof. Thurston was engaged in the collection of facts and data for use in the preparation of the series of articles which are in course of publication in our columns. The account of the engine here referred to, will appear in our columns at an early date, and it will no doubt interest our readers very greatly; especially as they are probably desirous of seeing what is the verdict in regard to an engine which Mr. Edison has used for so much of his work

ELECTRICITY IN NEWARK.

THE Annual Meeting of the Stockholders of the Domestic Telegraph and Telephone Company was held to-day. Newark is fast becoming one of the leading cities in electrical matters, and as the art advances, new developments bring with them the demand for labor. The Domestic company shows this very plainly. They employ fifty-four persons in constructing and maintaining their lines, and operating their business in all its departments, and it has grown to be of importance to our community and to all having use for the telegraph and telephone. Newark being one of the largest telegraph centres in the United States, we have the advantage here of both the principal systems. The offices of the company are lighted by the Weston incandescent system, supplied from the Mechanic Street station.

At the meeting to-day, Directors were elected for the ensuing year as follows: George W. Hubbell, Enos Runyon, Marcus L. Ward, Jr., John D. Harrison, Jabez Fearey, E. Luther Joy, Edward Weston, Frederick T. Fearey, and Jacob H. Dawson, Jr.

The annual report of the company, presented to the stockholders by the Executive Committee, contained some facts of general interest. There are now 224 call boxes in places of business and residences. During the year, four fire calls were responded to and the department notified. The twenty-nine messengers have performed no fewer than 104,280 errands during the twelve-month. Forty-one offices and stores use the company's burglar alarm, central office system, and twenty-eight places have been found open after having been closed at night. No articles of value had been taken in any case, as the alarm is instantaneous, and gives no time for the thieves to work. Five special police officers are employed in this department.

There are now 556 subscribers to the telephone exchange, and the enormous number of 1,016,895 calls have been answered during the year. In this department fifteen fire calls have been answered and the department notified. There are 658 miles of wire in use, and the company employs fifty-four persons.

The paid up capital of the company is $100,000, on which they pay to the city of Newark the same rate of tax as individuals pay upon their personal property, the total tax this year amounting to $2,060. Separate wires are run from the central office to each telephone subscriber, and all the latest improvements in call-bells, switches, operating tables, and other valuable changes have been added to the system.—Newark *Advertiser*, Oct. 20.

THE INVENTOR OF THE SUBMARINE CABLE AND TORPEDO.

THE first attempt to use torpedoes is generally credited to an Italian engineer named Lambelli. At the siege of Antwerp, in 1585, he floated boxes filled with gunpowder down the river with the object of destroying a bridge. These boxes were provided with mechanism which was to cause the explosion of the gunpowder on the boxes colliding with the bridge. The Americans, however, claim that David Bushnell, of Connecticut, was the first inventor of the mechanical torpedo. He was born at Saybrook, now called Westbrook, Connecticut, in 1742, and entered Yale College in 1771. During his residence at this college, he devoted a great deal of his time to the study of submarine torpedoes and mines. Another American, Robert Fulton by name, took up the subject with great energy at the beginning of the present century. At the time when England was thrown into a ferment by the numerous threats of invasion uttered by Napoleon Buonaparte, Fulton endeavored to get him to adopt his plan of submarine torpedoes, by means of which he promised "to deliver them and all the world from British oppression." He does not appear to have met with any encouragement from Napoleon, however, and he subsequently betook himself to the United States, where he published a book entitled, "Torpedo War, and Submarine Explosions." It is dated New York, 1810, and has the curious motto on its title page, "The liberty of the seas will be the happiness of the earth." His torpedoes were all to be fired by mechanical means, however. The invention of the voltaic battery, and its development, was to lead to its adoption for firing submarine mines. In 1829, when but a boy, Colonel Samuel Colt, the inventor of the revolver which bears his name, began experimenting in this direction. He worked hard until 1842, in which year, on the 4th June, he exploded a torpedo in New York harbor by means of the current from a battery, and on the 4th July following, blew up the United States gunboat "Boxer," opposite Castle Gardens. After this he was taken up by the American Government, and a sum of money, 17,000 dollars, voted him, to enable him to continue his experiments. On the 20th August, 1842, he destroyed a schooner on the Potomac river, when five miles away from her, and on the 18th of October, 1842, he blew up the brig "Volta," in New York harbor. It is generally conceded that Colonel Colt was the first to utilize electricity for firing mines. The following extract from "Torpedoes and Torpedo Warfare," by C. W. Sleeman (Griffin & Co., Portsmouth, 1880), will be read with interest "From Colonel Colt's private papers and memoranda, it appears that he claimed to possess a further secret, which died with him; but that his invention consisted principally in the arrangement of groups of torpedoes connected by insulated wires with each other and with the galvanic battery, and that one of his projects was to compel a vessel to tell her proximity by telegraph as she touched certain parts of his apparatus, or, by a method since adopted by the Austrians, the vessel's contact caused the circuit to close, and thus insured the explosion at the proper instant. To Colonel Colt certainly is due the credit of being the first to conceive of the project of igniting deposits of powder, placed in harbors for their defence, by means of galvanic electricity; and the cable employed by him in this connection was the first submarine cable ever invented for conducting the electric fluid, only differing from the most approved forms of present telegraphic submarine cables in the substitution of asphaltum and beeswax instead of gutta-percha, then unknown."—London *Electrician*.

THE GLOSSOGRAPH.

THIS instrument, it appears, was shown at Munich last year, where, I regret to say, it escaped my attention. Since then it has been much improved. The inventor, M. Gentilli, of Berlin, asserts that it is perfect. The glossograph is a very trifling looking apparatus, but it is almost magical in its operation. Its function, then, is to reproduce speech automatically as soon as it is uttered. Having been first placed in the mouth of the speaker, it is then brought into contact with the roof of the mouth, the tongue, and the lips. The glossograph is next connected with an electro-magnetic registering apparatus, which registers every sound automatically as soon as it is uttered. The characters thus produced are about the most comical looking gallimatias that I have ever seen, but they are said to be easily read off by the inventor, who, I fear, is likely for some time to retain the monopoly of this peculiar art. The glossograph, it may be thought, must be an awkward implement in the human mouth—as awkward, in fact, as a "bit" between a horse's jaws. That is not the case. It is constructed in such a manner as to cause the speaker no inconvenience whatever. M. Gentilli maintains that its presence in the mouth is almost imperceptible, but I am afraid that is not the opinion of those who have tried it. Anyhow, it is a very remarkable instrument. I understand its merits have been tested in the Italian Chamber of Deputies, and its usefulness much praised by those members who gave it a trial. In using the glossograph it is by no means necessary to raise the voice—*pianissimo* and *fortissimo* are all the same to the registering apparatus. It will reproduce a whisper or a shout with equal fidelity, but the more distinct the articulation the better the esult. This is the sole condition of its efficiency. With the aid of the glossograph it will be possible, in M. Gentilli's opinion, to write four or five times as fast as has hitherto been possible by even the quickest penman. According to this calculation, the speed of the glossograph would amount to something like 5,500 words an hour. I am aware that there are reporters who can turn out a column of the *Times*—say, 2,300 words—under 100 minutes, and that is nothing very wonderful. If the glossograph can really quadruple that performance and prove itself a reliable instrument, then, I am afraid, the reporter, like the sable Venetian hero, will find his occupation some day gone. Before that time comes, however, the glossograph will require to be considerably improved in one or two points. In the first place, the characters are almost as difficult to decipher as Mr. Shapira's famous sheepskins; and until M. Gentilli's newly invented alphabet is as well understood as Mr. Pitman's phonographic system, the reporter, I apprehend, will share the fate which the proverb assigns to threatened men. This is the fly in M. Gentilli's pot of honey, but I am informed that he is very sanguine of being able to remove it before long. He has given many years of labor and thought to the production of the glossograph, which is certainly a marvelously ingenious instrument; and, looking at the wonders of the telephone and the microphone, which are gradually reaching perfection, it would seem that M. Gentilli's invention is destined to accomplish all that he so fondly predicts of it.—Vienna Correspondent *Ironmonger.*

ANIMAL ELECTRICITY.

IN Dr. M'Kendrick's lecture before the British Association it was shown, by projecting its image on a screen, that the uninjured frog's heart, isolated from the body, still lives, and while beating gave with each beat an electrical variation, as shown by the swing of the galvanometer needle. The uninjured heart gives no current, but when slightly injured, there is a variation in its electrical state with each beat. Then the lecturer showed that light causes an electrical change in the eye. Placing the eye of a frog in the galvanometer cushions, it was shown that there was a current passing from the cornea to the back of the eye. In the dark, little or no change could be seen, except what might be due to the drying of the living structures forming the eye ; on allowing light to fall on the eye, there was at once an increase in the current. This continued for a time, then began to fall off, and on light being removed, there was another increase, and then a sudden and rapid falling off. This action, first shown by Professor Holmgren, Professor Dewar, and the lecturer, showed a specific influence of light on the retina. It could not be called a negative variation. It indicated chemical changes occurring in the retina. Lastly, the lecturer showed the production of currents from the living man. Placing the hands in two vulcanite troughs, communicating by platinum plates with the galvanometer, and filled with a weak solution of salt, he showed that on contracting one arm a deflection of the galvanometer needle was produced. When both arms were quiet there was no current ; on contracting one arm a current was at once produced. This current, the lecturer was inclined to think, was due to action of the fluid on the skin and not to currents from the muscles, and that the differences were due to the differences of contact. In summing up, after a few remarks regarding electric fishes, the lecturer said that all of these electrical changes were really expressions of the vital changes occurring in living tissues under the action of stimuli. It was no part of the functions of nerves, muscles, or of the retina of the eye to produce currents under the action of their relative stimuli, but such currents indicated chemical changes in the organs or tissues. For example, the contraction of a muscle is a movement following or consequent upon many chemical changes, among the results of which were the production of heat and differences of electrical potential. Thus there was no special production of electricity, except in the case of electrical fishes and possibly of some other animals. In most animals, including man, the production of currents was an incidental phenomenon, indicating chemical operations and nothing more. Besides, the currents so produced were feeble and evanescent, and bore no relation to the general well-being. Consequently, all attempts to influence the living body by magnets had no rational basis. The lecturer had tested this question by powerful electro-magnets, and had not been able to detect that they had the slightest influence on any vital phenomena. It need hardly be added that the so-called phenomena of animal magnetism are of an entirely different kind from those discussed. These are of a subjective character, dependent on peculiar states of the nervous system, having nothing whatever to do with electricity or magnetism ; but still in a sense they are phenomena as real as those of physical science. Their subjective character, however, renders them specially difficult of investigation, and consequently they are more liable to fall into the hands of the charlatan. One safeguard against this is the recognition of what the electrical phenomena of the living body really mean, and one purpose of this lecture will be served if it shows that to detect and account for these phenomena requires the most refined methods of the physicist and of the physiologist, and that they give us only a glimpse into the intricate changes occurring in living tissue.—*London Times.*

CURIOUS ELECTRICAL PHENOMENON.

AT Espelny the Count de Lus has a locomotive which drives a thrashing machine by means of a leather belt some metres in length. Standing near the belt, and to protect himself from the heat of the fire, he one day held open a parasol which had a wooden handle and a frame or bracing, made as usual, of iron. Happening to touch one of the braces he immediately experienced a sensible electric shock

The following day I repeated the experiment and obtained sparks about three-fourths of an inch long, following each other so rapidly as to indicate an almost continual current, the intensity of which seemed to depend upon the rapidity with which the belt moved. When the engine worked very rapidly, strong sparks escaping from the belt to the boiler produced a crackling which could be distinctly heard, though the daylight prevented them from being seen.

How could this be explained? Could it be attributed to electricity developed by the evaporation of water in the boiler, as in the hydro-electric machine of Armstrong? No, because the boiler of Armstrong's machine must be mounted on insulating pillars of glass, while in this case, on the contrary, the iron wheels of the locomotive rested upon and formed a communication with damp ground.

The explanation, which seemed to me satisfactory, is the following : The belt was not sufficiently tight, and the engineer resorted to the common expedient of powdering it with rosin in order to increase its adhesion to the driving wheel and pulley. Still the adhesion was not perfect, and by the friction between the pulley and belt, as in the usual electrophorous, the two fluids were separated. The frame of the parasol acted the part of a condenser, and as the belt was about ten yards long, and one-fourth of a yard wide, it presented a superficial area of about two and one-half square yards, upon which a considerable quantity of free electricity could be accumulated. I had no means of determining the species of electricity, but I think it was resinous.[1]

J. M. FOLACHE in *La Nature.*

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[1] **Bulletin de la Societe Scientifique d Argentau.**

THE ELECTRICIAN.

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ERRATA.

In article on "Electro-Motors," October paper, page 303, *first line, read "Clerk-Maxwell" instead of "Fleeming Jenkin," the quotation was made from memory, hence the error.*

ELECTRIC LIGHT TESTS AT CINCINNATI.

IN our last issue we gave a brief account of the electric light plants of the several competing companies at the Cincinnati Exposition, and called attention to the fact that, in accordance with a special circular issued by the exposition commissioners, scientific tests and measurements of the apparatus would be made. This special circular stated that "no expense has been spared in securing the services of a jury composed of the best scientific experts in the country;" also, that "in deciding on the best systems of arc and incandescent lighting, the jury will take into account the following factors, viz.: dynamos, lamps, conductors, fixtures, safety devices, regulating apparatus, manner of erection, including cost of operation, number of lamps per horse-power, economy, efficiency, etc., etc." From all this we judged that the tests would be thoroughly scientific and exhaustive. Since then the tests have been completed, and we regret to say that, from all we can learn, the work was done in such a hurried, crude, and slip-shod manner, that the results are anything but satisfactory, and should be regarded with suspicion, both from a commercial and a scientific point of view.

The jury recommended that the principal prizes be awarded to the Edison and Thomson-Houston companies, except the prize for the best arc dynamo, which was awarded to the United States Company. The latter company was so dissatisfied with the haste, the methods employed, and the general conduct of the tests, and also with the fact that the recommendations were made without giving any figures whatever, that they immediately filed a "protest" with the commissioners of the exposition. The commissioners saw fit to disregard this protest, whereupon the United States Company applied to the court, and obtained an injunction restraining them from making the awards, and also commenced proceedings for damages, on the ground that the commissioners had not fulfilled their contract.

We are more than disappointed at this result. Such fair promises were made that we had high hopes of at last obtaining accurate scientific data in regard to the prominent lighting systems, and the public will join with us in regretting the result. Not having seen any of the figures, nor even the results of the computations made by the jury, we are not in a position to critically review their work. It seems to us, however, very remarkable that representatives of the various companies were not permitted to be present at all the tests and measurements, and that the managers of the exposition should have made haste to confirm the recommendations of the jury, notwithstanding the protest of one of the companies interested, without having all the figures before them and carefully investigating the whole matter.

There is no danger or inconvenience in exhibiting reliable figures to all the world; indeed, an open inspection of the data is the principal safeguard of a jury who are to decide upon questions involving large commercial interests. Above all, secret methods are unscientific and to be avoided, especially in cases like this, where the result depends on facts capable of accurate scientific determination.

THE COURSE IN ELECTRICAL ENGINEERING AT THE CORNELL UNIVERSITY.

IT was announced last Spring that Cornell University would, at the opening of the Fall term, receive students for a course of instruction in electrical engineering. The announcement has created so much interest, and provoked so much enquiry, that we have endeavored to procure and present to our readers full information in regard to this new department of study

The requirements for admission are the same as to the other technical courses, civil and mechanical engineering, etc., that have been been so long established, viz.: algebra and geometry, in addition to the common English branches.

The course in the University includes the higher mathematics, the French or German language, rhetoric, descriptive geometry and mechanical drawing, physics, chemistry, the steam engine and other motors, besides the special work in electricity, which constitutes the special features of the course.

The instruction in electricity includes the use of all the instruments employed in making electrical measurements, with the means employed for testing their accuracy and determining their constants; the construction and testing of telegraph instruments; the methods of testing telegraph lines and cables; the theory, construction, and testing of dynamo machines; the study of the different systems of electric lighting, etc., etc.

The course is designed to give a thoroughly practical, combined with a theoretical, training, and the electrical engineer will find use for every subject named. The higher mathematics and pure sciences will be found of especial importance, now in the infancy of the applications of electricity, when so much is in the tentative stage.

The facilities for this instruction at Cornell are of the best. A large new building has just been completed, in which are several rooms specially equipped for electrical tests and measurements. All the important instruments for measurements are provided. Dynamo machines and systems of electric lighting are in practical operation in the building, and, as far as possible, all the applications of electricity are exemplified.

The student spends a considerable portion of his time in the laboratory, making experiments with the various instruments. He determines the laws and constants of galvanometers; measures the resistances of various conductors; measures the currents used for electric lights; determines the energy expended in charging and that developed in discharging storage batteries; determines the efficiency of machines and motors; in short, does exactly what the engineer needs to do in the factory or office.

KARL SIGISMUND RICHARD WERDERMANN.

THE death is announced, at London, September 13th after a long and very painful illness, of Karl Sigismund Richard Werdermann, the distinguished electrical engineer.

Born in Prussia, in 1837, he was educated for the army. Resigning from the royal artillery, he, in 1860, emigrated to France, and practiced in Paris the profession of civil engineer.

There he made the acquaintance of Gramme, for whom he conceived an ardent attachment, and whom he regarded as the greatest inventor of modern times.

When, in 1870, the people of Paris became hostile to Germany, he removed to England, and by deed, dated September 14, 1872, became the owner of Gramme's patents for Great Britain and the United States. He has since that time resided in London, and devoted himself to the advancement of electrical science.

In 1873 he lighted the clock tower of the House of Commons by electricity, the current being supplied by a Gramme machine. The illumination was for the purpose of indicating that the House was in session.

In 1875 he displayed an electric-arc lamp upon the roof of the Charing-Cross Hotel, and by reflectors lighted the Mall, and the Facade of Buckingham Palace, a mile distant. In the same year he exhibited, before the Institution of Civil Engineers, in London, the transmission of power by Gramme's machine. In the same year he introduced a Gramme machine into the General Post-office at St. Martins le Grand, to perform the telegraph work previously done by batteries.

In the same year he perfected the double-parallel insulated carbon candle, "having undoubted priority of invention over Jablochkoff," who obtained the patents, and whose name is permanently connected with the invention. The device was applied by Werdermann not only to lighting, but also for drilling stone.

In the same year he prepared elaborate plans for the illumination of the Centennial Exhibition, at Philadelphia (held in the following year). These plans were in detail, with estimates of cost, and contemplated not only the interior lighting of the vast buildings by his candles, so arranged that cross-lights cut off the shadows, but for a general illumination of the whole grounds, by means of lofty poles bearing powerful lights with reflectors.

In 1876 he invented an electric railway brake, an electric furnace, and a process for reducing refractory ores by electricity.

In that year a syndicate was formed to acquire the Gramme patent for the United States, and the importance of Gramme's invention being imperfectly comprehended, the inclusion in the contract of the refractory ore patent was demanded, and refused by Werdermann. That refusal cost him a great fortune, changed the direction of the business in this country, and delayed its development.

In 1878 he read a memoir before the French Academy of Science, on the "imperfect contact" or "infinitely small voltaic arc," popularly known as the semi-incandescent lamp.

In 1881 he exhibited at the Universal Exposition of Electricity, at Paris, his semi-incandescent lamp. It was shown in the president's room, the dining room, and the theatre, and produced a beautifully soft and pervading light, similar in effect to the carcel lamp, commonly used in France.

His chemical investigations extended over a wide range of subjects, and he was an accomplished civil engineer and mathematician. Brilliant, original, versatile and learned, he wanted continuous application to place him first in his art. Credulous, inconstant, sanguine, generous and unthrifty, without business instinct, knowledge or prevision, he died leaving a wife, three daughters and a son, wholly unprovided for and without a home.

R. R. H.

WHAT, THEN, IS ELECTRICITY?

THE Corean embassy have been busy sight-seeing among the great barbarians of the outside world, in this country; and carefully jot what wonders are seen and heard by them, in a note book. When they were escorted through the Western Union Building in New York they were highly entertained. The *New York Herald* thus relates an incident of So Kiang Pom, the secretary of the legation:

The electrical machinery was considered the most wonderful thing the Coreans had seen. They could understand the mechanism, but the current of electricity could not be explained to them satisfactorily. The pneumatic tubes, too, were regarded with wonder and admiration. The secretary of the legation, who was always very quiet and never lost an opportunity to make a few notes in a book carried for the purpose, wrote down a great deal about the electrical system, and then threw a great deal of zest into the general conversation by asking, through the interpreter, the simple question:—

"What, then, is electricity?"

After everybody had talked for fully five minutes in attempting to explain that nobody knew just exactly what electricity was, So Kiang Pom put up his pencil and gazed mournfully at the uncompleted chapter in his book.

AT a special meeting of the Gramme Company, held at its office, on Wednesday, October 17th, it was unanimously resolved to appeal from Judge Blatchford's decision, in the case Gramme *vs.* Arnoux, to the Supreme Court of the United States.

We foreshadowed this action in our editorial of last month, setting out the reasons why an appeal was inevitable.

—— WE HAVE SOME VERY interesting figures before us comparing the different modes of illumination in respect to the amount of products of combustion:

Light of 100 *candles.*	*Products per hour.*		
	Water vapor kilos.	*Carbonic acid in cubic metres.*	*Heat in calories.*
Electric lamp, arc	0	0	57-15
Electric incandescent	0	0	290-536
Gas, Argand burner	086	046	4860
Lamp, petroleum, flat flame	080	095	7800
Lamp, colza oil	085	100	6200
Candles, paraffine	099	122	9200
Candles, tallow	005	145	9700

These we think are quite sufficient to show the great supremacy of electric lighting over all other methods of illumination when considered as a matter of health, because it produces less carbonic acid, while the smaller amount of heat shows less waste in making light.—London *Nature.*

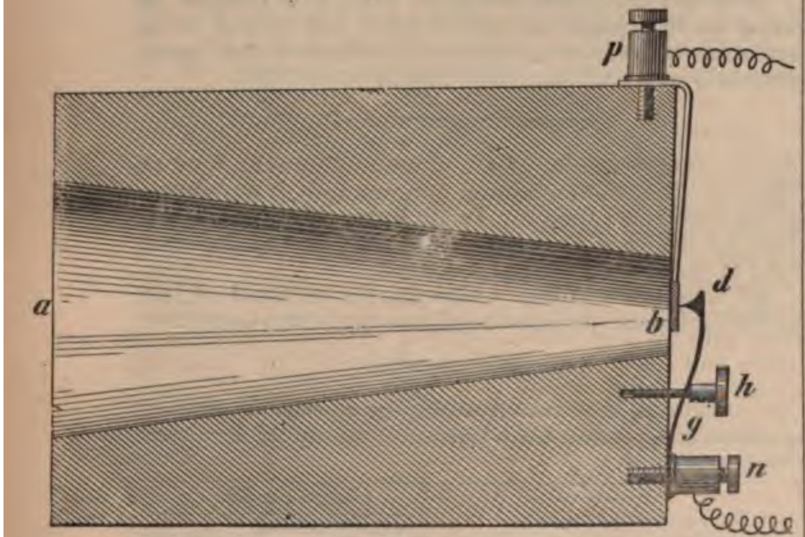
—— AN INTERNATIONAL SOCIETY OF ELECTRICIANS has been formed in Paris under the presidency of the Minister of Posts and Telegraphs, its main object being to centralize all information bearing on the progress of electricity, and to promote its spread and development. Information as to the society may be obtained by writing to M. Georges Berger, 99 Rue de Grenelle, Paris.

THE REIS TRANSMITTER.

THE world has an interest in knowing what relation Philipp Reis, of Germany, has to the speaking telephone of to-day, what he did is of great importance to us, because if he invented an electric speaking telephone twenty years ago, and made the invention known not only by descriptions of the device, but by making and selling his telephones in public market, it is clear that the credit for the invention belongs by right to him, and it is also plain that so much as he invented belongs now to the world, and ought not to be the exclusive property of any man or company of men.

On this question, as to what Reis did, there has been a vast deal of talk in courts, and a great deal of craftiness by lawyers has been displayed and the language has been so carefully shaped for the requirements, that if the language were like a machine it would no longer be fitted for ethical purposes. Let us see then what it was that Reis *did.*

1st, *He invented a certain device which he called the telephone.* It consisted of two parts, a transmitter and a receiver. Some of his constructions are in existence to-day just as he used them and left them. Let us examine the structure of his transmitters. He made 8 or 10 varieties, but they all involved the same idea. For the purpose, we will take the bored-block form such as he exhibited to the Physical Society at Frankfort-on-the-Main, 1861. It is in existence now, and the accompanying cut is a section of the actual instrument; *a b* is the conically bored hole through the block. A thin membrane is stretched over the smaller end, and a strip of platinum is glued to the middle of the membrane and continued upwards to the binding post *p* A springy piece of platinum, *g d,* is attached to the other binding post, *n,* and an adjusting screw, *h,* is provided for keeping the point *d* with proper tension against *b.* Now here is a device, a collocation of mechanical details invented and constructed for a specific purpose; namely, the variation of an electric current by means of sound vibrations, chiefly those of the voice, as the tube *a b,* plainly shows. Is it adapted to its purpose, and will it do the work for which it was designed? This is a question which may be answered in two ways, theoretically and experimentally. If the above instrument, or a fac-simile of it, be connected properly with a magneto receiver, its capabilities may be experimentally tested, and when thus tested, it is found to be a good speech transmitter, extremely sensitive as a microphone, and words spoken ten feet from it may be plainly heard at the receiver. If that be true, it follows that the Reis transmitter, just as he left it, is capable through its appropriate action of giving to the electric current its proper variations for the reproduction of speech, in other words, it yields the genuine undulatory current. What is true of this transmitter is true of the more common form of Reis transmitter: namely, the cubical box with the membrane on the top. Especially good will the results be, if the transmitter be coupled in the primary circuit of a small induction coil, while the receiver is in the secondary circuit.



Reis invented these transmitters for this purpose and he used them for the same purposes, and he said he heard words at the receiver which were spoken at his transmitter, and what he said was corroborated by quite a number of his contemporaries, several of whom are now living, but as an offset to the above it has been affirmed, and the courts have so ruled, that Reis *intended* that his transmitter should work in such a way as to make it impossible that speech could be transmitted by it; namely, he *intended* that the electric circuit should be broken for every vibration, and the evidence for it is his description of the working of his device. This declaration is equivalent to the assertion that what Reis invented was—not certain instruments for a certain purpose, but—*a theory of the working of certain pieces of apparatus;* and consequently, if Reis did not describe[*] the working of his devices correctly, he did not invent the devices, and consequently, the world has no right to his apparatus.

Again let us inquire what it was that Reis invented. Suppose that in place of the platinum terminals he had used iron, or copper, or carbon, or anything else, would it have changed the character of the device? Not at all. One might have answered better than another for the purpose, but all would act in substantially the same way, the differences would be altogether those of degrees and nothing else. Let a piece of electric-arc light carbon be substituted for the platinum in either of the forms of Reis's transmitters, and at once it becomes equal to the very best of modern transmitters. Why? Because the *intention* has been changed? No. Because the mechanical arrangements have been modified? No. Indeed, it is only because of the demand for a superior article of carbon for electric lighting that such carbon for transmitters has been adopted, as any one may verify for himself by trying any ten-year-old carbon stick in his transmitter. Has the one who substitutes the carbon for the platinum invented the *undulatory current?* It is preposterous. At best he has made the transmitter more useful, but, even in that place the function of the carbon is simply to vary resistance, and it had been put to that service years before.

2nd, *Reis described his apparatus and gave his theory of its action.* This is the part that is seized upon by the assailants of the claims of Reis as being the inventor of the speaking telephone. Suppose for argument sake, it be admitted that Reis expected to reproduce speech by means of an intermittent current, and that he *intended* that his transmitter should make, and break circuit for every vibration. It must be admitted that any automatically working device, can only work in accordance with the mechanical conditions present in the device, and no will, or intention, or theory concerning it will make any difference in its working, so long as it is not otherwise *compelled* to work differently, in which case it would not be automatic. What then does it matter how Reis thought his machine acted? His *theory* of its working might have been wholly wrong, yet its performance be wholly right. When *we* speak to a Reis transmitter we find it gives the proper undulatory current for the transmission of speech. *It must have done so for Reis*, unless physical laws have changed since his time, and it is not likely that any one will have the hardihood to affirm that; and it is only by trifling with the facts, and by ingeniously framing sentences, that conclusions hostile to Reis's claims have been drawn.

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[*] Judge Lowell said in a recent case: "I decided in *American Bell Telephone Co.* vs. *Spencer*, that Reis had not *described* a telephone which anticipated Bell's invention."

How then does the case stand? Reis did two things. He invented a telephone transmitter for the purpose of the electric transmission of speech sounds and any other. He succeeded in doing it, and we can to-day with the same instruments. He also *described* his devices giving a theory of their action, which in some particulars is inexact. These two things he *did*. The courts have decided, that because he did not *describe* the action of his device as we would describe it to-day, when used for the same purpose it was invented for, that the Bell company is, therefore, entitled to a monopoly of what he *invented* for the purposes for which he invented it. W. X.

THE TERM QUANTITY IN ELECTRICITY.

EFFECTS OF INTERNAL RESISTANCE.

BY SCHUYLER SKAATS WHEELER.

IF we ask a number of so-called electricians, what is the effect of connecting the cells of a battery in multiple arc, most of them will reply, that the battery is then set up for "quantity," and will give a current of greater quantity than if the cells were connected in series. That when the cells are connected in series they give a current of greater intensity, but less quantity, and that for certain effects a quantity current is needed, while others are produced by currents of great intensity only, thus speaking as if there were some characteristic or property of electricity which they designate by the term quantity. If we refer to the works on electricity, we will find the same inference.

From Ohm's law we at first get an idea that there are of electricity, two qualities or dimensions—electromotive force and strength of current, or pressure, and rate of flow; but, upon a more thorough consideration, we see that the strength of current, or rate of flow, is dependent entirely upon the E. M. F. of the electricity divided by that resistance which happens to be presented, and which has nothing to do with the electricity itself, being a mere opposition, so that in reality the only factor dependent upon the electricity is the E. M. F.

How, then, do we get this term quantity? Is it something which is overlooked in Ohm's law, or is it another name for some factor, or combination of factors, which enter it.

As we already know the effect in a circuit, or the strength of current depends upon the E. M. F. divided by the resistance of the circuit. Therefore, if a circuit in which it is desired to produce a given strength of current has a high resistance it is necessary to have a correspondingly high E. M. F., while if the circuit is of low resistance a low E. M. F. will produce an equal strength. There will be more energy of course in the circuit of high resistance, since, in it, there is the same strength maintained through a higher resistance or a longer circuit. In technical terms it has more volt-ampéres; but at any point on the high resistance circuit will be found the same strength of current, as in the one of low resistance. A needle suspended near them will make equal deflection in both cases. In fact, without making some alteration in the conditions of the circuit, it is not possible at a single point to detect any electrical dissimilarity between the two circuits. Now, although two circuits of widely different resistances, may have the same strength of current, and, therefore, be exactly similar except in the matter of length, they will be differently affected by certain changes.

For instance, if we place a coil of moderately high resistance in the circuit of low resistance, the current will be greatly weakened, since this coil makes the resistance of the whole circuit much greater than before, and consequently great compared with its E. M. F., whereas, if we place the same coil in the other circuit, of equal current, but, higher resistance, the strength will be but slightly reduced, since the resistance of this circuit is not materially increased by the coil. But we could not distinguish them until we had tried the effect of the extra resistance. If we break the low and the high resistance circuits, the former will not spark, and the latter will, simply because the resistance of the air across the break, entirely stops the current maintained by the low E. M. F. and does not at once stop the high E. M. F.

It is these effects of the *resistance of the circuit*, rather than any factor dependent upon the electricity, which give rise to the popular but very incorrect and misleading term "*quantity*" in electro dynamics. If the average electrician has to deal with a conductor traversed by a current of ordinary strength, and in drawing from it into another conductor he finds that he is not materially limited by the resistance of the first conductor itself as a source, he immediately says that its current is one of enormous quantity, when, as a matter of fact, there may be much less electrical energy in it than in the high resistance circuit spoken of above.

It is not the electricity itself, but the conditions imposed by the circuit through which it has to flow which determine whether or not the effect commonly called "quantity," is produced.

If the circuits in question are the internal resistances of battery cells—the cell having large plates close together and consequently low internal resistance, is said to be a quantity cell, simply because the low resistance which it offers, does not prevent the E. M. F. of the cell from producing a strong current when it is connected to an external circuit of low resistance. As far as the electricity itself of the cell is concerned, in the only property which electricity has—electromotive force—there is absolutely no difference between it in this cell, and in any other of the same plates and electrolyte. In fact, standard cells, standards, of E. M. F. of course, are generally constructed with exceedingly small plates, widely separated on account of the mechanical advantages of that disposition.

As the greatest E. M. F. obtainable by chemical action from any combination of substances is about three volts, and that obtained from the most common cells, little more than one volt, when a greater E. M. F. is desired from such a source, it is necessary to obtain it from a group or battery of cells, by coupling a number of them in series, so that the E. M. F. of the whole will equal the sum of their individual E. M. F's. This arrangement is subject to the drawback, that it also opposes the sum of their internal resistances to the current, whereas if the cells are connected in multiple arc, they are the same in effect, as one cell with plates just as many times larger, and while their joint E. M. F. is that of one cell only, their joint resistance is as many times less than that of one cell as there are cells.

To get the maximum effect through a high resistance, it is clear that we will gain more by the increase of E. M. F., resulting from connecting the cells in series, than we will lose by the accompanying increase of resistance, since the latter is only a small part of the whole. If the circuit is of very low resistance, the resistance of the cells, is a large part of the whole, and then the best way to arrange them is in multiple arc, since the total resistance of the circuit will be reduced thereby, in much greater ratio than the E. M. F.

Having recalled these facts, we see that for every external circuit there is a balancing point between these two extreme arrangements (it may, in certain cases, reach one or the other extreme), a specific grouping of the cells, which will give for that particular circuit the strongest current, and upon a little consideration, we see that this point is reached when the cells are so grouped that, *incidentally*, the internal resistance equals the external. This, not because, as a well-known electrician once said, "the strength of a battery is proportional to its internal resistance," but because, if in any case we depart from such a grouping as will carry out this proportion, by re-grouping for greater E. M. F., we lose more by the increased resistance, than we gain in E. M. F., and if we go the other way and arrange for less resistance, we lose more in E. M. F. than we gain in reduction of resistance.*

As the necessity for so great an internal resistance, results only from the fact that it is an unavoidable accompaniment of high E. M. F., when that is obtained by connecting together in series two or more sources of small E. M. Fs., *the application of the rule is limited to the grouping of sources.* When we have a *single* or indivisible source of whatever kind, we will get the greatest effect in the circuit when the resistance is at a minimum.

Therefore, it is *the internal resistance which is the limit of capacity of a source.* The question so often asked about storage batteries, How strong a current can you get out of them? reduces, since the E. M. F. is fixed by the nature of the elements, to the question, how low can you reduce the resistance of their circuits? If we reduce the resistance of the external circuit until it is nil, the strength of the current will evidently depend solely upon the internal resistance. If this is very low, the current will be very great, if it is high, the current will be feeble. If the source, battery or dynamo, had no resistance, the current would increase and decrease, directly as the external resistance decreased and increased. Hence, if such a non-resistance source, a dynamo for example, were possible, it would require no regulation when used in multiple arc systems of lighting and other distribution, because the current would increase directly in proportion to the number of lights turned on, and consequent decrease of resistance of the external circuit. But as it is impossible to construct a dynamo with no resistance, it is necessary to raise the E. M. F. a little in such a system, as lights are turned on, to compensate for this small constant factor in the circuit.

We have spoken only of *effect.* Effect, or power is secured always at a great sacrifice of efficiency or economy. In every case the greatest *efficiency* is secured when the resistance of the source is at a minimum, and that of the external or useful circuit at a maximum. In other words, when the useful circuit does the greatest possible part of the conversion of electricity into heat.

To sum up:

The term quantity is applied, improperly, to a current of any strength, great or small, when in a circuit of comparatively low resistance.

The greatest effect is produced when the resistance of total circuit is least, that is, when the source is short circuited.

The greatest effect from a number of sources, through a given external resistance, is secured when they are so grouped that the internal resistance equals the external.

The greatest useful effect and the greatest efficiency from a single source, are secured when its internal resistance is at a minimum; and

The greatest efficiency with any source is secured when its internal resistance is at a minimum, and the external resistance at a maximum. The effect is then at a minimum.

SIMILARITY BETWEEN ELECTRICAL CURRENTS AND WATER CURRENTS.

BY CARL HERING.

WHEN we read something in a foreign language in which we are not yet able to think, we naturally have to translate the words into our own language, before we can understand it. In the same way when we begin to work with electrical units, we endeavor either to "translate" them into the ordinary familiar units, the pound, foot, horse-power, etc., or else to compare them with their units. The former would not only be difficult but in many cases would not help us to understand them, as electromotive force, for instance, is a function of the square root of the unit of mass multiplied by the square root of the cube of the unit of length, divided by the square of the unit of time. It is much more satisfactory to compare the process of generating and using an electrical current, to that of some familiar mechanical current, and then to compare the measurements of the former with those of the latter. Although it is impossible to find an exactly parallel case in elementary mechanics, yet there are some mechanical currents which are so similar to the electrical currents, that they may be used as examples.

If in a vertical pipe full of water, a turbine wheel is made to revolve by some external force, the water will be forced out at the top and drawn in at the bottom. If the top of the pipe is connected to the bottom by means of a tube, a current will flow through this tube as long as the wheel is made to revolve. This represents mechanically almost exactly what takes place electrically, when the poles of a battery or electrical machine are connected by a wire; the wheel and its power corresponding to the battery and its chemical power, and the tube corresponding to the wire or external circuit. The difference of potential or electromotive force of the battery, corresponds to the difference of level or height to which the water is forced; the resistance of the battery and the external circuit, correspond, to a certain extent, to those of the water on the wheel and in the connecting tube; and the quantity of electricity to the quantity of water. An objection might be made here by

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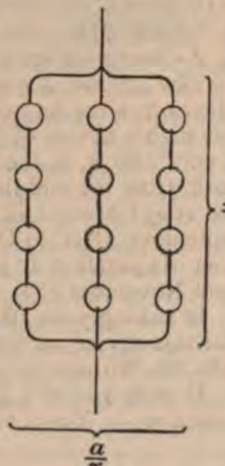
*Let A = total number of cells in battery, and when grouped,
" x = number in series,
then $\frac{A}{x}$ = number in multiple arc.



Let R = internal resistance of each cell,
" E = E. M. F. of each cell,
" r = external resistance,
then $\frac{x^2}{A} R + r$ = total resistance of circuit.
Let C = the strength of current,

$$\text{then } C = \frac{Ex}{\frac{x^2}{A} R + r}$$

Finding the first differential co-efficient of this, placing it = o, we have:

$$\frac{\left(\frac{x^2}{A} R + r\right) E - 2 \frac{x^2}{A} RE}{\left(\frac{x^2}{A} R + r\right)^2} = o$$

$$\text{whence } r = \frac{x^2}{A} R$$

Therefore, the maximum strength of current is obtained when $r = \frac{x^2}{A} R$, that is, when the internal is equal to the external resistance.

those who believe the electricity to be made of two fluids, positive and negative, which are separated in the battery, and reunited in the external circuit. This would make no difference in our example, as the direction of the current need not be considered. Besides, the better authorities have discarded the two fluid hypothesis and have advanced another which is much more satisfactory.

If it is required to increase the difference of level of the water, several of the turbines must be placed over each other, so that each one raises the same water to an additional height; that is, they must be placed in series, just as in the case of batteries or electrical machines, when high electromotive force is required, If the resistance in the tube connecting the upper and lower ends of the pipe (the external circuit) is very great, it is evident that great pressure will be required to overcome it, and to produce this pressure, the turbines or pumps must be placed so as to force the water to the greatest height, just as in electrical circuits great electromotive force is required when the external resistance is high. On the other hand if great quantity is required, and if the external resistance is low, then the turbine pumps must be placed next to each other; all the lower ends of the pipes being connected with each other and also the upper ends. The quantity would then be increased in proportion to the number of turbines, but the height or pressure per unit of area would remain the same as that of one turbine. This corresponds to connecting batteries or electrical machines in multiple arc, or for quantity.

This comparison helps one to remember the important fact, that when batteries or machines are connected in series, *i. e.* one behind the other, the whole current has to pass through each one, and that,therefore, the electromotive force and internal resistance are both increased in proportion to the number of elements; also, that when they are placed in multiple arc, *i. e.* next to each other, only a fraction of the whole current goes through each one, and that, therefore,the resistance is decreased in proportion to the number of elements, and the electromotive force remains the same as that of one element.

If in the external tube of the water current, a water wheel or some similar apparatus is placed,the force of the current will drive it and produce in it the same amount of work as was given out by the turbine producing current. This work can be increased either by placing a number of current producing turbines over each other (in series), or next to each other (multiple arc); in the first case a high pressure tube of small diameter would have to be used for the connection, and in the second case a large one of less strength. This corresponds to electrical transmission of power, in which it is also more economical to use a current of very high electromotive force and of small quantity.

Earth return circuits, the principle of which so many people have difficulty to understand, are also explained very nicely by the water circuit. If, for instance, the tube from the top of the turbine pump be led from New York to Boston, and there through some receiving apparatus to the ocean, while the bottom of the tube in New York be led to the ocean, the apparatus will work just as well as if the return be through a second tube, the ocean acting as a practically infinitely large reservoir from which the water is pumped out at New York and emptied again at Boston. It is an exactly parallel case to electrical earth return circuits, and shows that it is not necessary, as many suppose, that the same current must return through the earth from the second station to the first. The earth is an infinitely large reservoir for electricity just as the ocean is for water.

Our example also illustrates the difference between "static electricity," such as lightning or electricity from a friction or influence machine, and "dynamic electricity," such as is produced by batteries and dynamo electrical machines, and used for telegraphing and electric lighting. The first having a very high electromotive force, would be represented by a small quantity of water at a very great height; if it be allowed to fall it would attain a very great velocity, but being of small quantity would have little power. On the other hand "dynamic electricity" would be represented by a very large reservoir of water, but at a small height; if the water be allowed to flow out through a pipe it will produce a steady stream of small force, but as the quantity is large the power would be great.

In order to calculate the work which a quantity of water at a certain height is capable of doing, we multiply the quantity in pounds by the height in feet, thus getting foot-pounds. Similarly, if we multiply the quantity of electricity in coulombs, by the difference of electrical level or its electromotive force in volts, we obtain the work in volt-coulombs. Or, if the power is required we divide the work by the time in which the work is done, and by a constant, in the first case, and obtain the horse-power. Similarly, if we divide the volt-coulombs by time we obtain volt-ampéres, as coulombs divided by the time in which they pass through a wire gives the current strength in ampéres.

NEW YORK ELECTRICAL SOCIETY.

THE meetings of the New York Electrical Society were resumed Friday evening, Oct. 5th, after the usual Summer recess. President Small appropriately alluded to the death of Prof. Varley, of London, and appointed a committee to draft suitable resolutions on the event. The subject of the evening's lecture was "The Use of the Electric Light in Artistic Photography," which was ably presented by Prof. P. H. Vanderweyde, who received a unanimous vote of thanks at the close for his instructive and interesting lecture. A regular meeting of the society was held on the evening of the 19th of October, which was postponed to Friday evening, November 2d, at 8 o'clock.

The society is prospering generally. At the last meeting eleven names were proposed for membership. The circulating library of the society is now open, and members are availing themselves of its advantages.

BROOKLYN, N. Y., Sept. 28th, 1883.

To the Editor of the Electrician.

DEAR SIR:—In your September number of 1883, I saw with some surprise an article headed "*New Application of Arc Lighting Currents.*" I desire to call your attention to the fact of my having given an exhibition of just such a device of an electric light system, as described in your article, at the following places: 137 Elm St., New York, from the middle of June, 1882, for about 30 days, and 1003 Chestnut St., Philadelphia, Pa., from the 15th of September, 1882, to October 15, 1882, and said system has been in operation at 540 to 546 West 16th St., New York, from November 1881 to July 1883.

In calling your attention to this I simply wish to show that this device, as described in your paper, is not original with Mr. William Stevens, but with myself.

Hoping you will give this a space in your paper, in justice to Yours truly,

HANS J. MÜLLER,
28 Tiffany Place, Brooklyn.

—— THE TELEGRAPH has been used on Mount Washington, of the White Mountains, for many years to signal the weather to the Glen House on one side, and the Fabyan House on the other.

STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

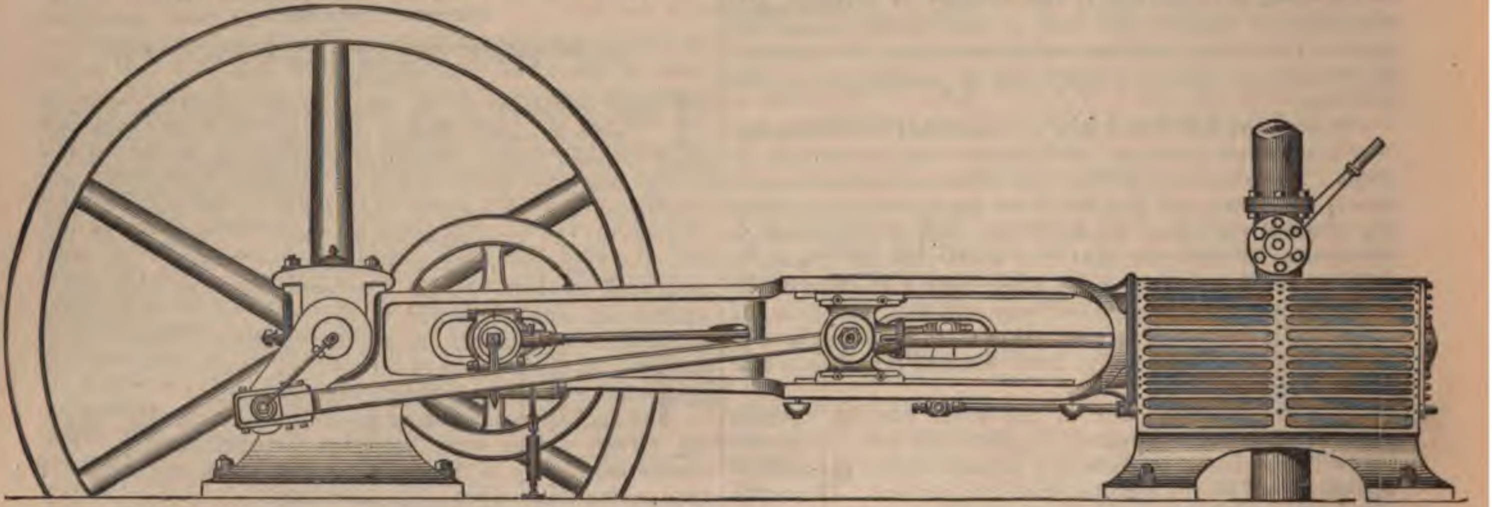
BY ROBERT H. THURSTON.

IV.—ENGINES CAPABLE OF DIRECT CONNECTION.

THE CUMMER ENGINE.

ALL of the class of engines now under consideration have been seen to differ radically from the engines previously described (as not well fitted for direct connection to the dynamo), and to have a number of characteristic points in common which especially fit them for use in direct connection. This latter class of engines, however, exhibit some differences among themselves which are important and very interesting to the engineer and the user of steam power.

The engine last described will have been seen to differ, in a very notable way, from that which immediately preceded it. The latter had a system of valves that differed from the former no less radically than did its system of regulation. We have now to study an engine which resembles the last in its general features—the use of a cut-off valve riding on a seat formed upon or in the single main valve, a system original in principle with Meyer, an engineer well-known, years ago, in Europe, and the use of the peculiar form of governor which adapts itself to a position on a horizontal or on an upright shaft with equal facility. This engine, however, has some curiously interesting and ingeniously contrived points of construction which, as well as its performance, make it well worthy of attention. This, the "Cummer Engine," is illustrated in the engravings to be described below.

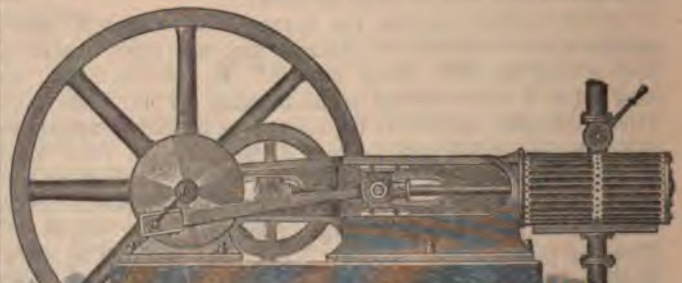


THE CUMMER ENGINE. "C."

The Cummer Engine Company makes a number of different forms of engine, using various kinds of valve-gear and different forms of regulator and of engine frame; but the style with which we are here principally concerned is that which is best adapted to driving a load at high speed with great economy and with the most perfect regularity.

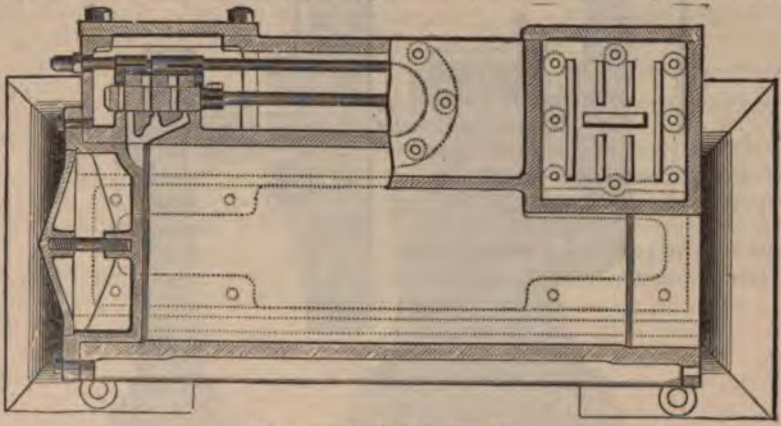
The general form of the engine, as shown in the above Fig., is very similar to that of engines already described. It has the "girder" frame, or bed, is well supported at each end, has a firm and substantial connection in the line of thrust and pull between cylinder and crank-shaft, and provisions for lubrication especially fitted to give safety at high rates of speed. A modified form of bed is seen in the next illustration, in which one of the engines designed for the highest safe speeds is shown. In this engine, the frame is made with a pedestal cast upon it directly under the guides and extending under the whole length traveled by the crosshead, thus giving absolute stability at the point at which cross strains are most severe and most productive of injury. The cylinder overhangs, unsupported, at the back end of the frame. No support is there needed, however, as no appreciable vertical stress occurs there. This engine has the same valve and gear, and the same form of governor as is used in the preceding style of machine. In this latter form of engine, the crank is replaced by a disc, an arrangement which enables the builder to effect a more perfect balancing of the reciprocating parts than can well be obtained with the ordinary form of crank. The rigidity of this form of engine is seen to be as essential a feature as in those which have been previously described. The box girder gives this stiffness in a very satisfactory manner.

The main guides are flat, and are fitted with removable faces which can be readily repaired or replaced, when worn or "cut," at small cost of time and money. The crosshead is a compact, strong casting, having bearing surfaces extending well out under the pin, and under the piston-rod socket, as well, and it is therefore not likely to cause those awkward accidents, due to springing the piston rod at this connection, which have proved so costly in less well designed engines. The gibs which take the wear are removable and adjustable. The main bearing is fitted with four-part boxes of babbitted cast iron, the side pieces so arranged that they may be set out to a bearing as they wear. All the details are in accordance with standard practice in this class of engines, and description is not called for here. It may be safely assumed that this is the case in any successful engine, as good workmanship, the best materials, and a strong system of connections, are essential pre-requisites to even the beginning of success.



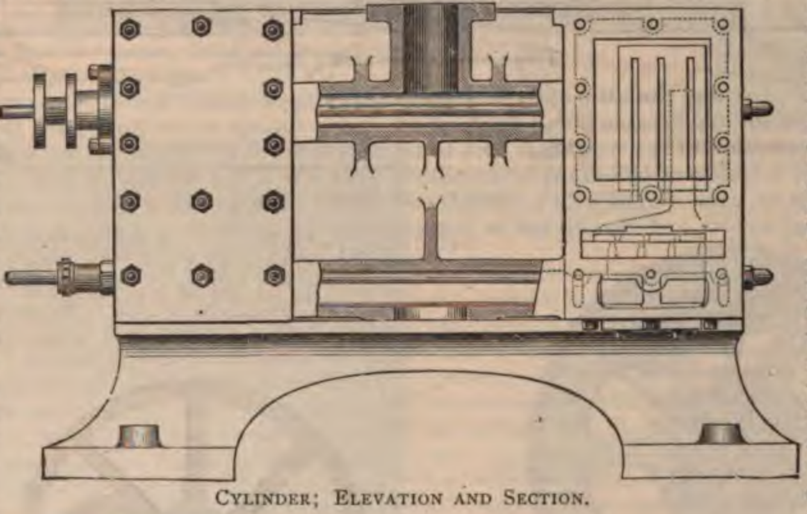
THE CUMMER ENGINE. "B."

The valves and the valve-gear of the Cummer engine, as has been stated, belong to the "Meyer system" and consist of a main valve with the cut-off valve riding on the back of the main. There is this difference, however, between the gear of this engine and others of the same general system: that here we find a separate system of exhaust valves which are worked independently of the steam valves, and thus leave the induction and eduction motions entirely free to be adjusted as the designer, the constructor, and the user, may desire. The preceding engraving shows the disposition of the valves in the cylinder casting, and the larger cuts exhibit the method of driving them. The section of the cylinder, above, is made horizontally through the steam valve chest, and shows the main valve in section, with the cut-off valve riding upon it. At the left is a section so made as to exhibit the exhaust valve seat. This is made removable. It will be noticed that the valves are of what the engineer calls the "gridiron" pattern. They are so made, with their several ports, to obtain a free opening with small movement and reduced friction of the valve. The writer has found this device a decidedly advantageous one, and it has been used by some of the most successful designing engineers of his acquaintance. The more numerous the ports, the less the travel required for the valve, the smaller the steam chest space demanded, and the less the load on valve-gear and governor, usually.



CYLINDER; STEAM VALVES.

The next illustration represents the same parts of the engine as seen from the side, with valve-chest bonnet removed at one end, and a section made opposite the supply pipe to show the passages and valve-rods. These rods are driven by the main eccentric, the steam valves directly, and the exhaust through a rock-shaft. The cut-off valve is driven by a separate eccentric, as in the preceding form of engine, and this eccentric, like the preceding, is adjustable in position on the shaft by the governor. The engine is thus made "automatic" in its adjustment of the point of cut-off, and in regulation. Separate valves are seen at each end of the cylinder, and the "clearance" and "dead space" is thus reduced to a minimum. This last provision makes it possible to "cushion" the exhaust steam up to boiler pressure on the return stroke, and thus to secure a minimum waste by condensation on the opening of the steam valve for the succeeding stroke. Cushioning is not here limited by the steam side. The construction of the connecting rod, and the method of connection, are such that the wear of journals and bearings may be taken up, in any case, without altering, to any observable extent, the position of the piston in the cylinder, and this permits small cylinder clearance, also. For the reason above given, the port spaces are made no larger than is necessary.

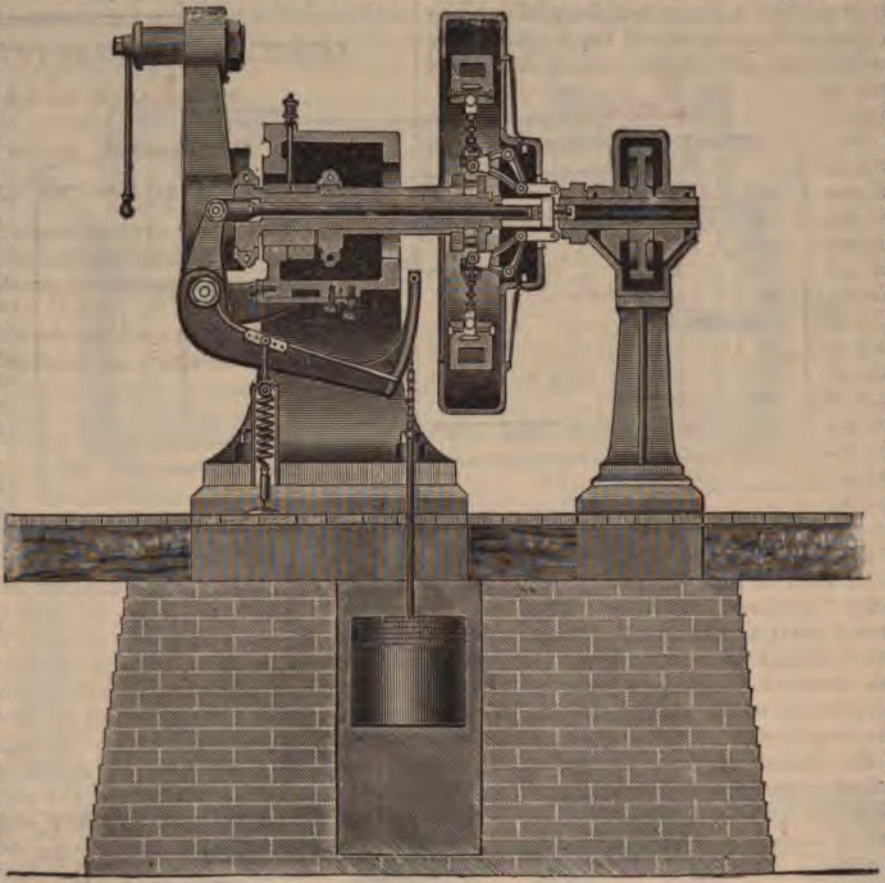


CYLINDER; ELEVATION AND SECTION.

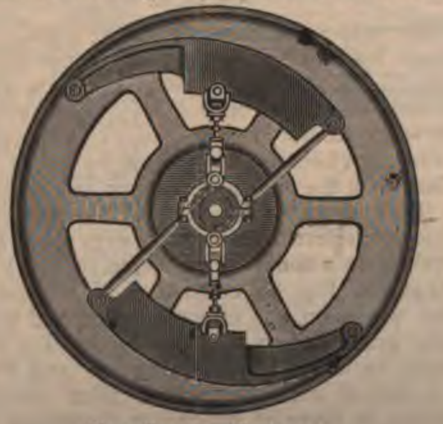
A comparison of this engine with others of its class will exhibit one very peculiar feature, in which this engine stands entirely alone. The governor is carried on a "governor shaft" which is geared to the main shaft, and which has no other office than that of carrying the governor and the eccentrics. It is evident that so radical a departure from standard design must have been caused by the possibility, actual or presumed, of thus attaining some very important result. A little study shows plainly what this supposed advantage must be.

The necessity of providing for efficient performance at high speeds of rotation has been seen to have compelled the adoption of a positive motion valve-gear; the adoption of this gear led to the use of a powerful form of governor, directly attached to the cut-off eccentric; this, in turn, compels the use of revolving weights, turning in orbits lying in the vertical plane; this last feature, in turn, again made it necessary, apparently, to place the governor on the main shaft, and to meet the effort of centrifugal force by a counterbalancing action, which could then only be obtained by the use of steel springs set in the casings of the governor. But the use of springs is considered by many engineers to be so objectionable, that they would submit to some expense and inconvenience to avoid their application, if possible. The objections are that they are liable to changes of tension and of length while at work, that they never have a definite and calculable strength, that they are liable to break in most unaccountable ways, and at most unreasonable and unexpected times, and that the adjustment of a balance between the two equilibrating forces is often difficult and almost always unsatisfactory. These objections undoubtedly do to a certain extent exist; but they as certainly are not as serious as is often supposed. The writer has had a long experience in this direction, both in the use and in the observation of the steel spring for a wide variety of applications, and has never yet seen reason to condemn them unreservedly. The principal objection which can be urged against the governor of this class, as usually adopted for the kind of engine now under consideration, is probably the fact that it cannot be reached while the engine is in operation, and that change of speed is thus made impossible except by stopping the machine and making changes in the adjustment of the springs, then trying the speed again, and again stopping to adjust, until the desired speed is exactly attained, which disadvantage is shared by the older arrangement of governor.

The form of the Cummer governor, which has been designed to evade these objections to the use of springs, and to secure certain special advantages, is shown in the above illustration and in that which follows. As has been seen, when studying the design of the engine as a whole, the governor of the Cummer engine is of the same general type as that of the engine last described; but it is mounted upon a shaft, separate from, and driven by gearing from, the main shaft. The governor shaft also carries the eccentrics, one of which is loose on the shaft and is controlled, as to position, by links from the weights of the governor as usual. The governor is thus enabled to shift the eccentric forward or backward and thus by changing its lead, to determine the movement of the cut-off valve and the ratio of expansion.


THE CUMMER GOVERNOR SECTION.

There is nothing specially remarkable about this part of the arrangement. The position of the weights is seen to be determined, however, by a system of bell-crank levers which connect the middle point of each weight with a vertical rod and chain under the engine bed, and on this rod is carried a set of weights which may be easily reached when the engine is running. The bell-cranks within the governor casing, move a rod which passes along the centre line of the governor shaft and emerges at the left. This rod enga[illegible] a large bell-crank at the end of the shaft, through [illegible] e engine is sustained.


THE CUMMER GOVERNOR.

But one spring, and that a small one, is seen in the whole system. The centrifugal action of the governor weights, when at the inner limit of their range, is met by the weights on the scale pan, and the spring is only required to meet the additional action of the governor weights when they fly outward, as the engine increases speed. The more nearly an equilibrium is maintained between the action of the flying weights and the balancing load, at the proper speed of engine and at all possible positions of the governor, the more perfectly "isochronous" does the governor become, and the more exactly will the engine hold its speed, under all variations of steam pressure and of load. With this governor, the weights on the pan can be increased or diminished at any moment, and to any desired amount, whether the engine is in motion or at rest; the isochronous adjustment can be effected as nearly as desired, and the speed of engine may, at any moment be altered, much or little as may be advisable.

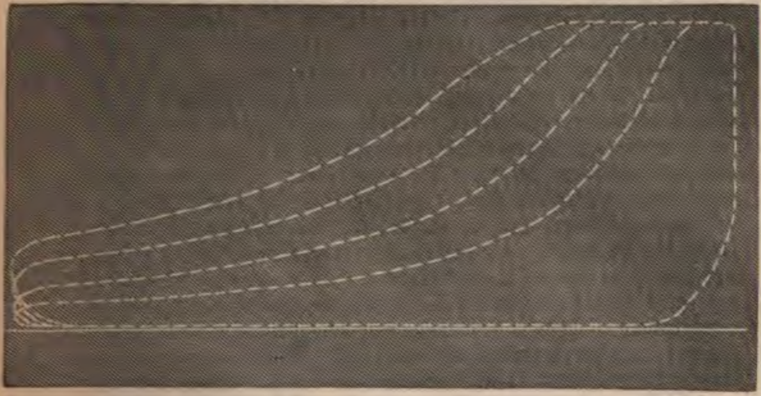
This accessibility of the governor, and the disuse of heavy springs to control it, are the principal advantages of this form of governor. It has also some incidental advantages which are worthy of notice, although of less importance. The governor shaft is comparatively small; this permits the use of very small eccentrics; this reduces friction and load on the valve mechanism, and this, in turn, adds a little to the efficiency of the engine, as a compensation for the introduction of an additional shaft. The one spring used here is smaller than that needed for other governors of the same class, and is relieved from tension entirely at frequent intervals, and the periods of "rest" thus given it are likely to insure an increase in its longevity which may prove to be a point in its favor worth mentioning. It may sometimes, although certainly not frequently, occur that an engine may be required to work, at different times, at certain different, but fixed, speeds. In such a case, it is easy, with this engine, to find a set of weights which when in place, will give each one of these fixed speeds; the engine can then be, at any instant, brought exactly to either speed by hanging on the scale pan the right weight for the speed. The several weights can be kept at hand for use as required. Such an arrangement may be sometimes especially useful in electric lighting.

Several styles of the Cummer engine, other than those which have been described, are built for the market. Those which have been here illustrated are, however, especially fitted for such work, as is the subject of this article. Both of the forms which have been described are well adapted to use in electric lighting plants, and are proportioned for high speeds; they are designed for nice regulation and are likely to prove durable, economical, and otherwise satisfactory motors. They are intended for steam pressures of 90 or 100 pounds per square inch, and their rated powers are based upon an assumed piston speed of about 400 times the cube root of stroke, as nearly as it can well be reckoned by the old method of James Watt—a speed more than three times as great as was thought best in the time of that great engineer. Even this speed is not to be considered remarkably great for engines designed and built, as are these, with especial regard to the requirements of high-speed motors. The steam pressures adopted are those generally regarded by engineers as, on the whole, the best for ordinary purposes, and are those beyond which the gain in economy by further increase becomes rapidly less with even the best engines. The point of cut-off is calculated, in estimates of power, to be at from one-fourth to one-fifth stroke, and, as a rule, nearer the first than the last figure. The best ratio of expansion for any given case is to be determined by a comparison of cost of fuel and steam supply with other operating expenses, at the place of operation.

The engine above described has been used, in many cases, to supply power for driving dynamos in electric lighting, and has an excellent record in that field, as well as in cotton and flouring mills, which demand the most perfect possible regulation.

One of these engines (16x36), at the Cincinnati Exhibition of 1883, was tested by the committee on electric lighting apparatus and found to alter its speed but 2½ per cent., when the whole load, 124 horse-power, was thrown on or off; it varied one revolution per minute with a change of steam pressure of from 90 down to 50 pounds.

The indicator cards, of which copies are given below as taken from this engine, show the method of distribution of steam in engines with positive motion valve-gears, such as are here considered as fitted for direct connection with large dynamos, and for high speed generally. The illustration exhibits a series of indicator diagrams taken from this engine at points of cut-off varying from one-tenth to one-third stroke. It is seen that the steam lines are as straight as those of a drop cut-off engine, very nearly up to the point at which the effect of closing the cut-off valve begins to exhibit itself in the production of the expansion line. The expansion curve is very nearly that obtained by laying down the hyperbolic curve of Marriotte, and the exhaust is as clean and prompt as need be desired; the back-pressure line closely follows the atmospheric line seen immediately beneath it, and the compression line at the right hand end of the card is quite as good as is often seen in the most perfectly proportioned engine with detachable valve. As the steam follows further and further, the sharpness of the corner between steam and expansion lines gradually becomes less, and the form of that part of the diagram approximates that found in the older forms of plain slide valve engine. For the most generally desired ratios of expansion, however, the form of the curve is satisfactory, and it is evident that the adoption of the positive motion type of valve-gear does not introduce any very serious loss of efficiency in this respect.



SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

XII—ELECTRIC SPARK IGNITION.

PART II.—SPARK EUDIOMETRY AND THE GAS ENGINE.

ABOUT the year 1778, a theory that the sanitary condition of the atmosphere was directly related to the proportion of oxygen it contained, prevailed almost as generally as the germ theory of the present day; and the name *eudiometer*, or measurer of the purity of the air, was given by Landriani to a vessel within which he confined a measured volume of air and determined its oxygen by absorption.[1] The facility with which inflammable vapors, and especially gases, take fire from the electric spark, led Mr. Alexander Volta, in 1778, to suspect that a confined explosive mixture—as for instance, of air and hydrogen—might be thereby fired, and by successfully effecting such an explosion in a closed vessel, to show that the oxygen of the air and a certain proportion of the hydrogen disappeared.[2] Immediately conceiving in this procedure a convenient expedient for removing the oxygen from a confined specimen of air, Volta devised the instrument, Fig. 80, consisting of a glass cylinder in which the explosion was effected, combined with a straight glass tube graduated to measure the residue of the explosion which he called a *new eudiometer*,[3] and which was the first of a class of instruments now called electric, or spark eudiometers, in favor of which the absorption eudiometers were for a long period abandoned.

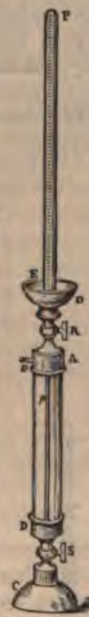


Fig. 80.—Volta's Spark Eudiometer. The gases are exploded in the cylinder A D, *by a spark applied by* v.

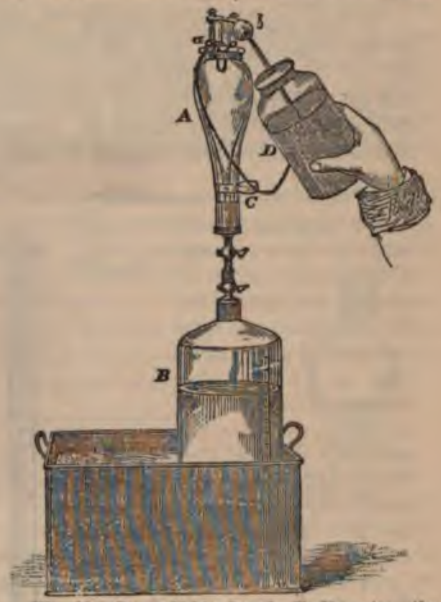


Fig. 81.—Cavendish's Spark Eudiometer, the symbol of the Cavendish Society. The mixed gases are collected in B, *and transferred to* A. *They are then exploded by a spark conveyed to the interior of* A, *by wires,* a, *inserted through the stopper, which is held in place by a clamp,* b.

Mr. Joseph Priestley and a Mr. Warltire, repeated Volta's experiment, using, however, *dry* vessels (that employed by the latter in 1781 being a closed copper globe), with a view to determine whether the disappearance of the oxygen and hydrogen, or the escape of the heat produced by the explosion, was indicated by a corresponding loss of weight, which was found to be not the case; but both noticed that a transparent liquid dew appeared within the vessel, without suspecting its source.[4]

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[1] Life of Henry Cavendish. Geo. Wilson, London, 1841; p. 219-221.

[2] Ibid, p. 152.

[3] Volta, Alessandro. On a new eudiometer. Della, *Scelta d'opusculi interesanti* di Milano. Vol. 34, p. 65; Sept. 2, 1777, et seq. Collezione dell opere del Volta. Firenze, 1816. T. III., p. 177. Also, Descrizione dell Eudiometro ad aria inflammabile. Brug. Ann., Vol. 1, p. 171; and Collezione Cit. Ibid T. III., p. 197-263.

Henry Cavendish, while studying the atmosphere with a form of Volta's instrument devised by himself, which, however, was quite different from that universally recognized as Cavendish's eudiometer, and the symbol of the Cavendish Society, Fig. 81,[5] observed that the transparent liquid was an invariable product of the explosion, equal in weight to the volumes of oxygen and hydrogen that disappeared, and by exploding in portions a large volume of a mixture of *pure* oxygen and hydrogen he finally collected a considerable quantity of the liquid and discovered it to be *water*, of which he thus first synthetically demonstrated the composition.[6]

In his earlier experiments Cavendish was embarrassed by the observation that the water formed from hydrogen and *air* contained nitric acid, and was thereby led to a second great discovery, namely: the composition of nitric acid, which eventually, by means of a suitable spark eudiometer, he synthetically formed from nitrogen and oxygen.[7]

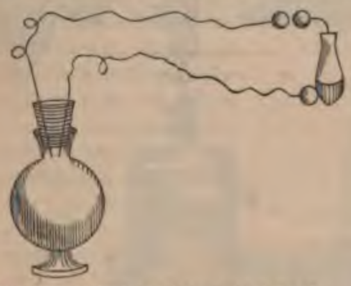

Fig. 86.—Volta's first gas pistol fired by a small Leyden jar, 1777.

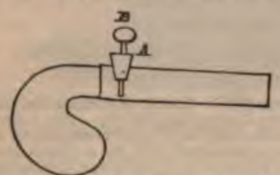

Fig. 87.—Modification of Volta's gas pistol, Golding Bird, 1848.

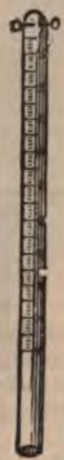

Fig. 82.—Volta's Eudiometer.

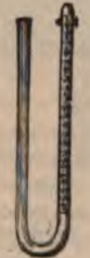

Fig. 83.—Ure's Eudiometer.

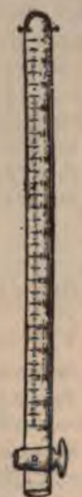

Fig. 84.—Mitscherlich's Eudiometer.

These brilliant achievements rendered the instrument at once the object of much attention. Further simplified by Volta—who abandoned the additional cylinder, and inserted the spark wires in the graduated tube itself, Fig. 82; by Ure, who gave it the U form, Fig. 83;[8] by Mitscherlich, who added the tap, Fig. 84;[9] by Bunsen, who bent the spark wires up close against the glass, to facilitate cleaning and guard against their displacement by the explosion, as is shown in the same Fig.;[10] by Hoffman, who, reviving the *U* form, added a second leveling tap below,[11] and in minor details by others, the eudiometer has always retained the form of a tube, graduated, until recently, in cubic centimetres or cubic inches, but now more simply graduated in linear millimetres, and calibrated to accord with any measure of capacity, and with as much accuracy as may be desired by the operator himself.[12]

Applied in connection with processes chiefly suggested by Bunsen,[13] and improved by Regnault and Reiset,[14] and others,[15] the eudiometer has given rise to a special method of chemical investigation called *eudiometry*, which has proved of extraordinary utility in the analysis of the atmosphere and of illuminating gas. Since in the latter process the same volume of gas is sometimes repeatedly exploded, a globular form may be given to the explosion reservoir, as in Hempel's gas pipette, Fig 85.[16] In all of these instruments, except the first, the igniting spark is produced between platinum wires inserted as shown in the figures, by fusion, through the glass, and in most of them the violence of the explosion is relieved by the compression of a column of air, the lifting of a column of mercury, or by other devices. Eudiometers of the Mitscherlich class must be made extremely thick, in order that the glass may withstand the explosion; but the difficulty of preparing and annealing such instruments is so great, that one seldom remains sound for any length of time. After one has been made for months, it sometimes spontaneously explodes.

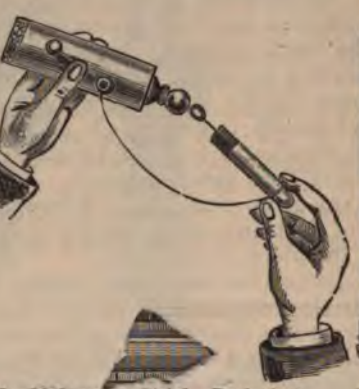

Fig. 88.—Modern Gas Pistol. Revival of Volta's small Leyden jar.

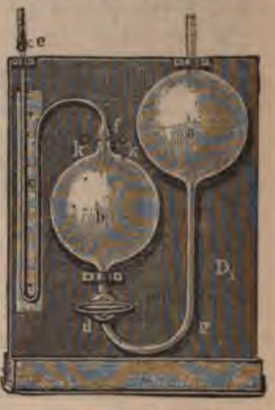

Fig. 85.—Hempel's Gas Pipette.

But Volta, anticipating in the explosive power of confined gases, electrically ignited, which he illustrated by the simple apparatus, Fig. 86,[17] a possible future resource

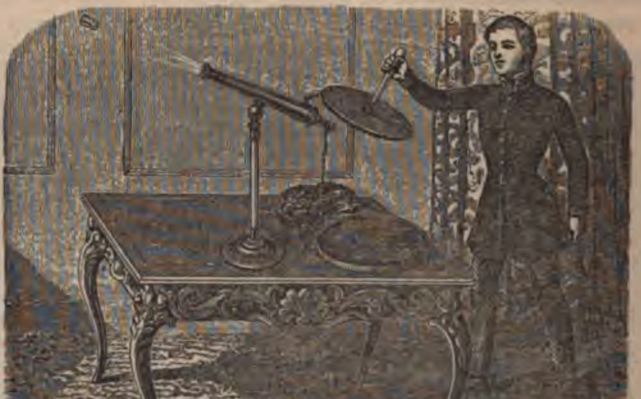

Fig. 89.—Gas Cannon fired by the Electrophorous. Ganot, 1860.

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[4] Life of Henry Cavendish. Geo. Wilson, London, 1841; p. 199.

[5] Ibid, p. 42, Cut from Inorganic Chem. Miller, N. Y., 1868; p. 43.

[6] Cavendish, Henry. Trans. Roy. Soc., 1784; p. 119. Also, Biog. Generale, nouvelle, Paris, 1854. Art. Cavendish. Claim disputed. See water controversy, Life of Cavendish. Wilson, London, 1841.

[7] Life of Cavendisn. Ed. cit.; p. 255-263.

[8] Ure. Paper pub. by Roy. Soc. of Edinburgh, 1819.

[9] Griffin. Chem. Handicraft. London, 1866; p. 263.

[10] Bunsen. Gasometry. Trans. by Roscoe, Walton & Maberly.

[11] Hoffman. Modern Chemistry,

[12] Prof. McLeod. Lecture on Eudiometers. Kensington Sci. Lectures. London, 1879; p. 285.

[13] Bunsen, Loc. Cit.

[14] Ann. Chim. Phys. (3) LXXVI; p. 333.

[15] Williamson & Russell. Proc. Roy. Soc. Vol. IX; p. 218. Frankland and Ward. Chem. Soc. Jour., Vol. VI., p. 197.

[16] Hempel, Walther. Neue Methoder zur Analyse der Gases. Braunschweig, 1880; p. 66.

[17] Volta. Three letters to F. Castelli, April and May, 1777. *Scelta d'opuscoli interessanti* de Milano. Vol. XXX.; p. 86-97. Vol. XXXI.; p, 2. Collezione dell opere del A. Volta. Firenze, MDCCCXVI.

of the art of war, also suggested a device which, in the form of the gas pistol, Figs. 87[18] and 88,[19] or the electrical cannon, Fig. 89,[20] is as yet but a familiar toy. It is held over an unlighted open gas jet for a moment, corked, and a spark produced between insulated points within it, when the cork is driven out with a loud report.

This device has, however, proved available, not as an accessory of the art of war, but of the industrial arts. About the year 1845, Lenoir devised a gas engine, in which the power stroke of the piston was produced by the explosive combustion of confined gases, and he endeavored to produce the ignition by the electric spark. But no electric source then available seemed adaptable to the purpose, and it remained for Mr. Riair,[21] by the application of the dynamo electric machine, to thus effect the explosion, which in the gas engine regulated in speed and power by the adjustment of its explosive fuel, is required at every power stroke of the piston, and to progress toward a realization of the apparently prophetic ambition of Lenoir, namely, the adaptation of the gas engine to all practical purposes.

THE BRUSH STORAGE BATTERY.

BOSTON, October 21st, 1883.

A PARTY of about two hundred gentlemen assembled at Willimantic on the afternoon of Wednesday, October 3d, to inspect the operation of the Brush storage batteries which are in operation at the mills of the Willimantic Linen Company.

These batteries, it is said, have been in constant use for three months as a part of the electric plant for lighting one of the mills. Each set of batteries is contained in a wood tank about ten feet in length, two feet in width, and two and a half in depth, which is divided by transverse partitions into twenty cells. Each of these cells contain three lead plates sixteen inches square, which are corrugated so deeply that the superficial area is some forty times that of the cross-section of the plates. The two extreme plates in each cell are called the hydrogen plates, and connected to one pole, while the middle plate is termed the oxygen plate, and connected to the other pole. The cells are filled with water, slightly acidulated with sulphuric acid to render it a good conductor of electricity. We are not advised as to the strength of the solution, but it was so weak that it could be tasted without annoyance, and was not so sour as vinegar.

In its original theory it may be stated that if an electric current be passed through a pair of lead plates which are coated with the red oxide of lead, and immersed in dilute sulphuric acid, the effect of the electricity will be to transfer the oxygen from the red oxide of lead on the negative side, reducing it to pure spongy lead, and adding this oxygen to the red oxide of lead on the positive side, thereby producing peroxide of lead. The transfer of the oxygen gas from one chemical combination to another, by means of electricity, is quite similar to the transfer of metal in electro-plating operations. When the lead plates are connected by means of an electric conductor, this change reverses; and as the oxygen returns to its former combinations, an electric current is produced in just the opposite direction from the charging current. Those lead plates which received the positive current from the dynamo, yield the negative current to the incandescent lamps.

The storage battery is an instance of the law of conservation of force, which may be expressed in this manner: Electricity produces a chemical change; this chemical change, in reverting to the former combinations, gives forth electricity. This is the merest abbreviation of the chemical changes which actually take place. Those who desire to investigate the matter are referred to a series of articles on the subject by Messrs. Gladstone and Tribe, which appeared in *Nature* about a year ago.

At Willimantic, each of these Brush storage batteries have a resistance of four and a half ohms, and they are charged by a sixteen-light Brush dynamo in eight hours. This enables the storage batteries to sustain two hundred and fifty Swan incandescent lamps for three and a half hours. The electromotive force of the current from the storage batteries is constant within working limits, and independent of the tension of the charging current. In this instance, the charging current from the dynamo made for arc lighting was four hundred volts, while the current from the batteries was thirty-eight volts electromotive force.

The switches in the mains in the circuit for charging the batteries, were very neatly operated by an automatic current manipulator, invented by Mr. Brush, which also contains a clock which registers the time occupied in charging the battery, and thereby furnishes the data necessary to compute the electricity required by the battery.

The Swan incandescent lamps used in connection with these batteries need no special mention here. The carbons are made of cotton thread twisted very hard, and still further condensed by drawing through a die. Then it is reduced to parchment by means of sulphuric acid before being carbonized. These lamps were run at a higher degree of incandescence than is customary with other incandescent lamps; and it was stated that they required 1 horse-power at the water wheel for each eight lamps, sustained at sixteen candle power. The resistance of these lamps is sixty-two ohms cold, and thirty ohms hot. The resistance of one battery circuit is less than one ohm. The electromotive force of the current was thirty-eight volts, which gave a current of one and twenty-seven hundredths ampéres per lamp.

While the lamps were in use, the connections were not merely switched open between the battery and dynamo, but to satisfy the incredulous were pulled out of the binding posts. During the evening, while the batteries were in operation, the charging dynamo, in conjunction with another one, was used to sustain the arc lights at a new trotting park, about one mile from the mill. Thirty-eight Brush arc lights illuminated a half mile track so perfectly that all the horses could be clearly distinguished on the further side of the course as they sped around the track. J. C. E.

ALLEGHENY, Pa., Oct. 17th, 1883.

Editors of the Electrician:

GENTS—I have been wondering what effect it would have, to pass an electric current from a small hand magneto machine through an inductive coil. Being a reader of your valued paper, I thought it might interest other readers (who, like myself, need brushing up of "contact points," so to speak, of our minds) if you would give your views, or permit the inquiry a place in your columns, and perhaps induce (or induct) some comments thereon.

Would it increase the intensity of a current from a hand magneto-electric in the same proportion that it does from a cell or series of cells?

Very truly yours, THOMAS D. GILLESPIE.

OUR PARIS CORRESPONDENCE.

PARIS, Oct. 6th, 1883.

IT is somewhat curious, that to electricity only is vouchsafed the power of giving a certain amount of animation to the Paris market, even at this time, when everybody is complaining of the dullness, if not the nullity of business. I would be one of the first to rejoice, if this revival was a normal result of the progress of the electric industry, and not of the efforts of certain persons whose financial enterprises have won for them rather doubtful reputations. Electric accumulators have been selected this time as a pretext for a call for funds. The way chosen was to offer the shares of an English company, and thus avoid, at the same time, the requirements of our French law with regard to companies and the control of shareholders, in case the operation should not succeed. I do not care to go into the details of this financial manœuvre, but I must confess that it was very skillfully conceived, and showed even rare talent in that line.

M. Phillipart is the commander-in-chief of these expeditions against French capital. He began by getting up these promenades in electric tramways, of which so much has been said lately. He it was who opened a store on the Boulevard Montmartre, where the Faure-Sellon-Volckmar accumulators may be seen working sewing machines, small presses, and machine tools. He also manufactures electric velocipedes; in short, he makes use of every method of acting on public opinion; he gives dinners to the press, illuminates the Grand Hotel, and balks at no puff or humbug. I have pointed out, on several occasions, how questionable were all these calculations based on accumulators, and there is no need of returning to the subject. Special publications, both here and abroad, are unanimous in their criticisms of this system of electric traction, as applied to such an important undertaking as the Paris General Omnibus Company. The only reply that M. Phillipart has made to his contradictors, is simply, that the Faure-Sellon-Volckmar accumulators are immeasurably superior to anything seen hitherto in this line, and such a statement on his part, does not inspire us with any great confidence. He has only too often displayed his remarkable talent at transforming the stockholder's money into worthless bits of paper, and we foresee a new operation of the same kind; but this time the public will be well forewarned, and if they let themselves be caught, why, so much the worse for them.

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[18] Bird's Elem. Nat. Phil.
[19] By courtesy of Curt. W. Meyer.
[20] Peck's Ganot, N. Y.; p. 405.
[21] Pat., 1882.

Here and there we meet with electricians who believe in the traction system, and the *Electricien* recently published a careful article, wherein figures were lugged in to prove that horse traction in Paris costs 65 francs, while traction by accumulators would come to only 39 fr. 65c., under the same conditions. But under this last figure the items of rent and labor have been left out by the writer. Nor must it be forgotten, that the omnibus horses contribute an important contingent to the *octroi*, by payment for feed, and that the substitution of accumulators for horses would make the city government put on special taxes as a means of compensation; so that, while we acknowledge the merits of the article from which we borrow these data, we must, at the same time, deny the conclusions arrived at. Tramway traction by electric locomotives will not be cheaper than that by horses, as long as accumulators remain what they are. The unsuccessful trials in England, place the matter beyond doubt

The remarkable results obtained at Grenoble in the electric transmission of power, according to the views of M. Marcel Deprez, have also formed a subject of general discussion. I have expressed my opinion pretty freely already with regard to the experiments made at the station of the Chemin de fer du Nord, in March last. I may, therefore, be now allowed to state that important progress has been made, without, however, having yet succeeded in solving the industrial problem. We are looking forward to the coming of a grand discovery that may give room for many applications, but at present everything is in the experimental state.

M. Marcel Deprez was the first to have the idea of transmitting several horse-power to a distance by electricity. He showed the possibility of the matter at Munich, then in Paris, and now at Grenoble, where, for the first time, a seven horse-power has been transmitted with two electric machines, distant some 14 kilometres (9 miles), over the ærial telegraph wires. The power was measured on the brake of the receiving machine. This experiment, however remarkable in itself, will have no industrial importance if it is going to stop there. It is admitted that machines that can transmit sufficient power for the needs of the work shop, have yet to be built; and here, there is no use in denying, lies the whole difficulty.

I recently instanced a trial in which 31 effective horse-power, measured on the receiver, was transmitted between two machines. The experiment was made with the simple view of ascertaining if the machines could do such a continuous work, and not to find out the distance their work might be transmitted; and the observations made in presence of Messrs. Tresca, member of the Institute; Potier, professor in the Ecole Polytechnique, and Marché, president of the Society of Civil Engineers, had this point only in view.

I am far from concluding from this, however, that 20 or 30 horse-power can as yet be sent to a long distance by electricity. Electric machines of this power can now be seen working at the Vienna Exposition (the first trial took place Sept. 19), but they are placed near one another. I think it proper to insist upon these details, so that my readers may not be tempted to believe that the problem of electric transmission to long distances has been really solved. Hitherto, great horse-power has been transmitted to a short distance, and small power to long distances, and that is the whole of the matter.

The Grenoble experiments are none the less worthy, however, of attracting attention. They were made with the Gramme machine, as modified by M. Marcel Deprez; the generator was placed at Vizille, and the receiving machine at Grenoble, a distance of 14 kilometres. The double telegraph line in silicon bronze of 2 millimetres, which served as conductor, had a resistance of 167 ohms. The generator was actuated by a turbine, by means of a gearing placed on the main shaft. The work was measured by a Prony brake, and there is every reason to believe in their correctness.

The following table summarizes the principal results obtained on September 1:

Number of Revolutions per Minute.		*Horse-power.*		
Generating Machine. I.	*Receiving Machine.* II.	*Furnished to Generating Machine.* III.	*Received by Receiving Machine.* IV.	*Effective Prod'ct, Transmission Deducted.* V.
720	484	6 97	3.30	47.3 per cent.
730	446	8 20	3.55	43.2 "
732	406	8 96	3.69	41.1 "
865	614	8 33	4.19	50.3 "
865	586	9 82	4.66	47.4 "
875	558	11 05	5.08	45.9 "
946	712	8.42	4.86	57.7 "
954	686	10.10	5.46	54. "
970	662	11.46	6.02	52.5 "
1040	830	9.69	5.66	58.3 "
1040	778	11 08	6.19	55.8 "
1050	734	12.33	6.68	54.1 "
1140	875	11.18	6.97	62.3 "

As may be seen from the table, three trials were made for a sensibly constant speed of the generating machine, by varying the load of the brakes of the receiving machine, and bringing it successively to 6, 7, and 8 kilogrammes, which explains the differences at each step in the product. In column IV., the work furnished to the generating machine is calculated with deduction made for the work absorbed by transmission, which is not strictly correct, for the cases will be rare where the generating machine can be directly connected with the driving shaft. The loss of power by transmission is, however, rather slight, according to the experimenters—hardly more than one horse-power, at the maximum.

The figures which I have considered as being of sufficient utility to reproduce here, are extracted from the official report of the committee appointed by the Mayor of Grenoble to follow the experiments. We cannot deny these results categorically, but neither should their importance be exaggerated. The committee believed that the results they observed could be expressed by a simple formula, and they concluded their report by saying that the product could be expressed by the produce of the velocities of the electric machines, multiplied by a co-efficient a, or:

$$R = \frac{n}{N} + 0.72$$

(n and N, number of revolutions of the receiving and the generating machine.) One has only to refer to the above table, to see that this expression is incorrect; thus, for the last experiment, we would have:

$$R = \frac{875}{1140} + 0.72 = 55.26$$

instead of 62.3, which sufficiently shows what faith we should have in such an empirical method. It is sufficiently established, besides, that the product is not in general equal or proportional to the produce of the velocities. We think it advisable to point out this cause of error—often involuntary—on the part of experimentalists.

I have spoken already of the organizing, in Paris, of an international society of electricians, and I even criticised it, so as to draw down on me some remarks from certain of its founders. I have not changed my opinion since, but I have to rectify one among others of my views, owing to recent modifications in the statutes. So the forms of the interior management of the society will not be submitted for the approbation of the Minister of Posts and Telegraphs, contrary to what the first statutes laid down. With this exception hardly anything has been changed in the ends and aims of the society. I do not believe there are sufficient elements in it to keep a society in existence I would only be too happy to be mistaken, but really what is most lacking in France to an electrical society, would be independent electricians; I mean by this, those that would be in no way officially connected with the government. The telegraphers are in the hands of the State; the professors have the Société de Physique, and outside of these two categories of persons who are by their occupations compelled to give more or less attention to electricity, it may be asked, can the industrial interest alone furnish a sufficient contingent of members? I do not think so, and I have come to the conclusion that the independent element would be inevitably rendered powerless in the society by the official element. Besides, the small success that the Paris Syndical Chamber of Electricity has had, goes to prove how very difficult it is to bring together, for any common purpose, men that are usually kept asunder by daily competition.

Moreover, an association of electricians has been formed in Vienna, on the occasion of the exposition, and it is probable that it will receive the support of the German *savants* and electricians. England has had a very flourishing society of electricians and telegraph engineers for a long time. The French society would be, therefore, doomed with being an international society only in name.

I have pointed out, in a previous letter, some of the advantages of using wires of silicon bronze for ærial lines of telephone. The results that have been obtained in putting down the telephone system in the city of Rheims, deserve a mention. The municipal government wanted to have the system experimented with before adopting it, and for this purpose put down, over a portion of the way, wires in silicon bronze, $\frac{11}{10}$ (?) of a millimetre, and over another portion, steel wires, of 2 millimetres, using the same kind of bearers for both wires. It was found that after several months' use everything was in perfect condition and order on the silicon bronze lines—not an upright or insulation bearer had stirred, while, on the other hand, numerous injuries were observed in the posts and cross beams that supported the steel wires.

The cause of these accidents appears to be solely imputable to the weight of the steel, for which the supports were not strong enough. Larger size supports should have been used, but this would have required a very large increase in the cost of putting up the system. The silicon bronze wires, moreover, left nothing to be desired in the way of telephonic transmission; it was even found that their small diameter made it possible to do away with the sourdines, that are indispensable for deadening the vibrations of steel wire, and which very often disturb communication.

The use of the electric battery has been justly found fault with, when cheap illumination was sought to be secured by it; still, there are circumstances that make the cost of secondary importance, and when it is impossible to use electric machines, on account of the limited nature of the quarters, and the battery appears the only acceptable solution, if gas is not to be had recourse to. We have several instances of this in Paris, especially in a restaurant near the Palais Royal. When the movement for cheaper gas began, the proprietor of the establishment did not rest content with offering a platonic resistance; he shut off the meter, and put up incandescent lamps, fed by bi-chromate of potash batteries (Trouvé system), in his saloons. He has had no reason to regret his initiative, for his customers, before accustomed to the hot and enervating atmosphere arising from the gas combustion, highly appreciate the advantages of the electric light and respirable air that it procures. As for the cost, it is certainly more than that of gas, but with a little care and looking after, the difference is but slight, and is largely compensated for by the volume of business. It is not every day, even in Paris, that people have an opportunity of dining with the electric light, and during the summer a number of persons offered themselves this harmless distraction.

Ph. Delahaye.

OUR VIENNA CORRESPONDENCE.

Vienna, October 8th, 1883.

THE attractions at the Exhibition have been increasing daily; new exhibits have been added, and improvements, which experience has shown to be necessary, have been made, so that the Exhibition is now in its most attractive state; both the electrician and the general public find an almost unlimited number of attractions. The large fountain in the midst of trees and shrubs, supplied by a large gramme motor and centrifugal pump, and illuminated from the inside by twelve large Jablochkoff candles, is at last in good working order. The scientific lectures are so well attended that it is often impossible to obtain admission. The electric railroad carries many hundred passengers every day, and the cable transportation of coal is wotking well. One of the greatest attractions is the ballet in the theatre, in the east end of the building. The whole theatre is lit with incandescent lights, those on the stage being so arranged that they may be made of numerous different colors, the change requiring only an instant. The effect of this on the many fairy-like dancers, surrounded by appropriate scenery, is one of the finest of the kind we have ever seen; especially pleasing is a combination of red and blue, apparently from different sides of the stage, blending from one to the other on the dancers and their delicate costumes.

In one of the courts is a small theatre, in which is exhibited an electric fire apparatus, which is so complete that it would be quite impossible for a fire to make any headway where the apparatus is introduced. When a fire breaks out on the stage, the apparatus opens all the doors, lowers an iron curtain, starts a heavy shower of rain, on any one or on all parts of the stage, opens a large ventilator at the top of the building to allow the smoke to escape, notifies the fire companies of the fire and starts the loud ringing of a bell, so that the fire has very little chance to do any great harm. The apparatus for performing the mechanical part of the work are very simple and not liable to get out of order; they consist essentially of two parts, one electrical and the other mechanical, the former being merely an electro-magnet, which by attracting an armature unlocks an escapement, and allows the mechanical part, which is actuated by weights, to do the real work; the levers of the escapements being so arranged that only a very small amount of force is required by the magnet to release them. The amount of current, and, consequently, the number of cells of battery, are therefore reduced very much—10 to 16 Leclanché cells being sufficient for a moderately large building. The contact points are so arranged that any one, or all together, may be actuated at the will of the operator, or by the fire itself. The latter is done by stretching strings across the top of the stage, the tension of which separates two contact points; if the string is burnt, the points are allowed to come in contact and thus close the circuit. The contact points being all in multiple arc, any one will be sufficient to start one or more parts of the apparatus, according to the connections. In such cases where the strings would be liable to be broken, another device is used; it consists of a fuse of gun-cotton fastened on strips of wood or on the wall, one end being connected to a small cylinder containing some powder; when this explodes it releases an escapement and thus makes contact. When all the pieces of apparatus are to be actuated the escapement is so arranged that the current flows for a few seconds through each apparatus, one after the other, so that it need not be strong enough to supply all the electro-magnets at once. The attendant is required to test each apparatus once a day, to make sure that it is in good condition—of course, turning off the water first.

The number of things "made" by electricity here are both interesting and amusing. In the Austrian exhibit are two large glass cases containing two sets of the same plants, started at the same time; the one having received sunlight only, while the other was illuminated by the incandescent light, the plants being without light only two hours out of the twenty-four. Those in the second case average two and three times the size of the similar plants in the other case, many of them containing flowers and buds, while those in the first case are not yet beginning to bud. The exhibitor thinks he can more than pay the expense of the light (produced by batteries) by the greater amount of flowers produced. Perhaps we will soon be able to eat electrical strawberries and watermelons, at our

Christmas dinners, and order flowering century plants at short notice.

In one of the interiors is exhibited a pyrograph, consisting of a handle containing two stout, insulated wires, coming together in a point at the end; if a current from a small dynamo or a few accumulators be passed through them, the point becomes very hot and may be used to draw ornamental designs on wood. It is used in this city by a cabinet maker, to ornament furniture, and panels on wooden ceilings and wainscoting. Another novelty is a horse and carriage on which are attached small incandescent lamps fed by accumulators under the driver's seat. The lamps may be attached on the front of the shaft, on the horse, or the carriage. By a simple switch the battery may be connected to a bell, so that if any one attempts to take a seat in the carriage, in the absence of the driver, a loud alarm will be rung, the connection being made with the springs under the seat. It might be suggested here, that the horse might be frightened more than the intruder.

One of the smallest exhibits here, is a little glass case which contains some small discs of copper, zinc and silver, and is labeled "Electrogenious." Upon examination we found them to be small batteries for curing neuralgia in and around the mouth. They consist of a silver tube about ⅛ inch long and ⅜ diameter, in which are placed five sets of thin discs of zinc, paper and copper, as in any ordinary voltaic pile. The ends of the tube are closed with silver discs which are screwed in, pressing the plates closely together. The silver is perforated with numerous holes, allowing the liquid to enter on all sides. To use the little battery it is dipped for a moment into salt water, and then placed between the gums and the cheek where the neuralgia is, one pole being against the gum and the other against the cheek. It is easily renewed by taking it apart, washing it and replacing the paper discs with new ones. Half an hour is said to be sufficient to cure the pain.

Another apparatus, although not new, is of interest. It is to illustrate the conversion of dynamic into static electricity, and vice versâ. It is made by Gaston Planté, and consists of 320 small cells containing two small lead wires immersed in dilute sulphuric acid; the poles all terminating in vertical strips of copper an inch or two long, which press lightly on an insulated horizontal cylinder, the negative all on one side and the positive on the other. This cylinder has two horizontal copper strips fastened to it, diametrically opposite to each other and running along its whole length, so that when it is turned that the poles of the cells touch the strips, all the negative poles are connected, and likewise all the positive poles, that is they will be connected in multiple arc. In the same cylinder, in a plane perpendicular to the one in which the longitudinal strips are, there are short wires run through it, making an angle with the axis, so that if the one end of the first wire touches the positive pole of the first cell, the other end of it will touch the negative pole of the second cell; the second wire connecting the positive of the second cell with the negative of the third, and so on; by turning the cylinder through 90° from its first position, the batteries are all connected in series. In connection with this is a condenser with a similar apparatus for connecting the plates in series or multiple arc. To change dynamic into static electricity the cells are first connected in multiple arc and charged with an ordinary battery. They are then put in series and charge the condenser which is in multiple arc; if the battery is then disconnected and the condenser plates put in series, a bright spark, similar to that of a Holtz machine, will be produced. The reverse process is, however, the more interesting. The condenser plates are first put in series and charged from a Holtz machine, then in multiple arc and connected with the batteries, which are in series After repeating this several times, and then connecting the batteries in multiple arc, a quantity current can be obtained from the batteries which shows decided magnetic qualities.

Unfortunately, our space does not allow us to describe the very interesting apparatus of Prof. Puluj, of the so-called "Crook's tubes." In a very interesting article on the subject* Prof Puluj explains all the phenomena by the well-known laws of physics, without the aid of any such hypothesis as "Crook's fourth state of matter." He also comes to the conclusion that electricity is matter and not force, the rational theory, which is accepted by most scientific men.

CARL HERING.

TORNADOES.

IN a recent issue of *Science*, Prof. Edward S. Holden gives the following suggestions for local warnings against tornadoes.

"I have lately examined with some care the excellent compilation by Sergeant Finley, of the Signal Service, 'Characteristics of Six Hundred Tornadoes,' with reference to the question of devising a simple apparatus for saving human life. Saving property seems to be out of the question, as no structure can withstand the force of the tornado wind. Life may be saved by recourse to underground shelters, cellars, etc., such as actually have been built in many places for this end. Two facts may be quoted from the work named: 1. Three hundred and forty-seven out of three hundred and ninety-three tornadoes (that is, eighty-eight per cent.) originated between the west and the south south-west points; 2. The average velocity of progression was about one mile in two minutes. . . . If five minutes' warning could have been given at any of the late tornadoes, many lives might have been saved. If each household could be warned by the continuous ringing of a bell, for example, that a wind of destructive force (say seventy miles per hour, and upward) was approaching, and that five minutes were available in which to seek shelter, this would be well worth doing.

"I have found that it is practicable to erect, at a moderate expense (less than $500), an apparatus which would give from three to five minutes' warning to all the inhabitants of a small town, by the firing of a cannon, for instance; and, in addition, and without any increased expense, this apparatus could ring a bell in every house. The additional expense to each house would be less than $10, the cost of maintenance would be less than $100 a year, and the work could be done by any intelligent person. The system, for a small town, would be something like the following: Suppose a circle described about the town, with a radius of from two to two and one-half miles. The only serious danger from tornadoes is to be feared from the part of this circle between the west point and the south south-west point. Along the circumference of this circle, between the south south-west and west points, run a line of single telegraph wire on twenty posts to the mile, and from the west point bring the wire into the town, letting it end at the telegraph office. It is grounded at each end of the line, and at the telegraph office it is connected with a battery, which sends a constant current over the line. Within the town, connection is made in various houses with magnets Each magnet holds a detent, which prevents a bell from being rung by the action of a cheap clock-work governed by a coiled spring. If the circuit is broken anywhere in the line, each bell begins to ring, and continues to sound till its spring is rung down; for four or five minutes, for example. A cannon could be fired by a simple device, which would warn persons in the fields, etc., to seek shelter. In a large town the circuit might end in one of the engine-houses of the fire department, and ring a bell there. This would be the signal for the man on watch to repeat the warnings simultaneously through as many local circuits as desirable.

"It remains to indicate the way in which the circuit is to be broken by the wind. The circuit of telegraph poles from the south south-west to the west points would contain about fifty poles. On every one of these the wire would run first to an insulator, then to an iron horizontal axis screwed into the side of the post. On this axis a piece of board one foot square can revolve freely. An iron rod projects below this board, and from the lower end of it a small wire goes to a pin in the telegraph pole. This pin is connected by wire to a second insulator. From this the line goes to the next pole, and so on. The circuit ordinarily passes to the first insulator, thence to the iron rod, thence down the iron rod to the thin wire, through the pin and to the second insulator, and so to the next telegraph pole. The thin wire is a necessary part of the circuit. It is so made that it will break when the pressure of the wind on the square board is fifty pounds. The apparatus for each post is tested practically before it is set up. This can be done at any time in a simple manner. Whenever any single one of these boards is subjected to the pressure of fifty pounds, its wire will be ruptured, and the circuit will be broken, thus sending the necessary warning along the whole line. I have made one such indicator, which is connected with a small bell in this observatory. The wire is arranged so, that it breaks at a wind velocity of about ten miles per hour, and it works in a perfectly successful manner. The extension of the system for the protection of a small town is a simple matter. For a large city a more expensive system would have to be provided, as the wires between poles should be carried underground to protect them from the chance of disturbance."

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*Strahlende Elektroden-Materie. Dr. J. Puluj. Vienna, 1883.

SHOP ILLUMINATION.

WITH the return of the shortening days of Autumn, many manufacturers are doubtless turning their attention anew to the question of shop illumination. Fortunately, in these days of arc lights, incandescent lamps, water gas, coal gas, and gas machines, the choice of an illuminant is not restricted to one or two kinds. There are enough to choose from, but which is the best to choose? That is the puzzling question which individual judgments must decide, and which it would be outside the province of a trade journal to discuss. The economic side of the problem, however, gives rise to several interesting suggestions. Of course, the primary object of shop illumination is to allow a longer day's work. Under the old-fashioned machine shop *regime*, now generally in vogue, the men are provided with lamps, of disagreeable odors and uncertain light, which, being only useful when placed directly alongside the work in hand, are generally ten or twenty feet away when most needed. To the half-time additional wages for night work must, therefore, be added the loss of time in going after a lamp whenever needed; in groping about in the dark for monkey wrenches and other tools, and in laboring under the disadvantage of never knowing exactly where the aid of the lamp will be next needed. It is a question of simple economy, therefore, whether a brightly lighted shop does not save money for the proprietors, in the long run Progressive manufacturers are beginning to see that it does; that more and better work can be accomplished by the men where they are not hampered by the restrictions above noted, and that, within reasonable limits, an illuminating plant is bound soon to pay for itself. Of course, however brightly the shop may be illuminated, however effectively shadows may be destroyed by counter-lights, some lamps will be needed to assist in work about the machinery; but the advantages of a steady, uniform and all-pervading light can scarcely be overestimated. We are glad to know that the progressive spirit of the age has not stopped in our shops, with the introduction of improved tools, but is extending also to the comfort and convenience of the workmen as well.—*Western Mechanic.*

SPARKS.

—— TELEPHONIC COMMUNICATION has been established between Alpnach and the hotel on Mount Pilatus, Switzerland, so that tourists may ascertain the state of the weather on the heights before making an ascent.

—— THE COMMISSIONER OF PATENTS, reversing a recent decision in his office, has awarded priority of invention of the incandescent conductor for an electric lamp, formed by carbonized paper, to Sawyer & Mann against Edison.

—— MESSRS. EDISON, GRAY, VAELKER, AND IRWIN, have filed appeals from the decision of the Commissioner of Patents, rendered six weeks ago, in which the most valuable inventions in the telephone were awarded to Alexander Graham Bell.

—— LIGHTNING HAD A CONTROVERSY with a Connecticut barbed-wire fence, and though considerably tangled at first on the sharp points, it finally charged along the whole line, making the staples fly and splitting, *The Waterbury American* says, "any number of posts."

—— AS THE PAPERS OFTEN refer to Chinese telegrams sent to and from Europe in connection with the Franco-Chinese negotiations, it may not be useless to state that a special code of telegraphy has been devised for the use of the Chinese. All the characters of the Chinese language have been numbered, and these numbers are sent by telegraph as secret messages. On arriving in China they are translated into Chinese numbers for the use of Chinese officials.

—— THE HONORABLE MARK FRANCIS NAPIER, of the Temple, London, who achieved great distinction by his brilliant and successful defence of Arabi Pacha at Cairo, and is English counsel of the Gramme Company, is paying a brief visit to the United States. His father, Lord Napier and Ettrick, was British Minister at Washington, and universally popular there and here.

—— MR. KELLINGWORTH HEDGES read a paper (Sept. 29) before the British Association, on the "Fire Risks of Electric Lighting," from which it appeared that, in addition to the usual and well-known precaution to be followed in erecting an electric installation, it was necessary that the purchaser should have the work superintended by some person on whose skill he could rely.—*Engineering.*

—— AT A BANQUET given in Paris by the Metropolitan Electric Lighting Company, a surprise awaited the guests as they left the table. A gigantic tramway carriage, moved by electricity, entered the courtyard of the hotel, and cleverly manœuvred in the narrow space, the great crowd wondering that there was no accident.

—— AT A RECENT MEETING of the Balloon Society, in London, a lecture on flying was delivered by Mr. Martin Farquhar Tupper. The lecturer based his anticipations of seeing human beings capable of flight upon the assumption that, in these days of electricity, aided perhaps by some lighter gas, some condensed form of tamed dynamite—these elevating and motive powers, assisted further by exquisite mechanism, either as attached to the human form (if the flyer were an athlete), or by quickening a vehicle with flapping wings impelled by electricity, in which the flyer might sit if he happened to be of stout habit, ought to be so manipulated by chemists and mechanicians so as to result, and very soon, in the grand invention that would supersede every other locomotive—namely, human flight. But if we would fly, let us imitate a bird, content to know that nature's way was the best, perfect; and let our humility be sure that the closer we copied her the more likely we were to succeed.

—— A NEW RECORDING TELEPHONE.—*The Pall Mall Gazette* describes a new telephone which Mr. Arthur St. George, an English inventor, has just patented. Supplementary to the telephone itself is a contrivance which will, it is stated, not only record every description of conversation carried on through the instrument, but will reproduce the words at any future time. A circular plate of glass is coated with collodion and made sensitive as a photographic plate. This is placed in a dark box, in which is a slit to admit a ray of light. In front of the glass is the telephone diaphragm, which, by its vibrations, opens and closes a small shutter, through which a beam of light is constantly passing and imprinting a dark line on the glass. Vibrations of the shutter cause the dark line to vary in thickness according to the tones of the voice. The glass plate revolves by clockwork, and the conversation, as it leaves the telephone, is recorded on the sensitive plate, the words spoken being fixed as is done in photography. The plate can be brought forward afterward, and when replaced in the machine and connected with a distant telephone will, when set in motion, give back the original conversation.

—— MESSRS. SIEMENS & HALSKE have brought out an instrument called a torsion galvanometer, to be used for large currents. It consists of a magnet suspended between two coils, so as to be affected by both, but to which is attached a torsion spring so arranged that the amount of torsion necessary to bring the needle back to its normal position can easily be determined. These instruments are made in two forms, a vertical and a horizontal form. In the vertical form the needle is suspended by a cocoon silk, and the reading is taken from above; this is the more delicate form. In the horizontal form, which is meant for more practical work, the needle is balanced on knife edges, and carries at one end a light pointer, which passes behind a scale. The amount of torsion required to bring the needle back to zero is indicated by another pointer attached to a handle, and which moves in front of the scale. These instruments can be used either in main circuit or shunt; in the latter case they are often used in conjunction with a resistance box, so arranged as to reduce the fall of potential between the terminals of the instrument in a known ratio. It is necessary, however, to use a table of calibrations, which are subject to very little change with time.—*Nature.*

—— ADVERTISING ENTERPRISE has seized upon the incident of a mishap with dynamo, in a manner which truly illustrates a feature of American humor. We regret that circumstances compel us to omit the name of the panacea which is alleged to have brought relief. "Don't monkey with the battery." This sign was displayed in the dynamo room of the Electric Lighting Company. Inquisitive spectator didn't mind it. Thought the wires looked as though they wouldn't hurt. Took hold of one of them. Suddenly sprawled on the floor at some distance. Back severely sprained. Shoulders bruised. Thought he was killed. Found he wasn't. Half an hour's hard rubbing with pain killer put him in fairly repaired condition. Says he won't monkey with battery wires any more.

—— THE ELECTRIC RAILWAY from Portrush to the Giant's Causeway was opened Sept. 28th, and among others present were Sir William Thomson, Sir William Siemens, and Sir Frederick Bramwell. It is over six miles long, and has cost $225,000. The line, after passing through the principal street of Portrush, follows the seaside road, a portion of a footpath six feet broad being reserved for the railway. The gauge is only three feet, and the gradients are very steep—in places as much as one in thirty-five. The force to work it is generated by a waterfall in the river Bush, with an available head of twenty-four feet, the electric current being conveyed by an underground cable to the end of the tramway. The water power passing through turbine water wheels, which utilize the whole force of the fall, is said to amount to ninety horse.

—— COMMON AS THE TELEPHONE now is, let me remind you that if but six short years ago it had been suggested to you that we should within two years of that time be able to reproduce at a distance not merely sounds, but articulate speech, and not merely articulate speech, but every trick and accent of the voice of the sender, so that any one listening could say, "That's my friend," or "That is a stranger," or "That is a Scotchman," or "That is an Irishman" who is speaking, would you not have scouted it as the language of an enthusiast? Yet it is but six years ago. In this age the world very soon becomes accustomed to marvels; it does not wonder long—not even the proverbial nine days. I believe if to-morrow you found a man comfortably flying from the top of this building to the end of the pier, and alighting there without injury, it might attract spectators for about a week to see a daily repetition of the flight, and at the end of that time they would pay no more attention to it than if they had been in the habit of seeing men fly ever since they were born.—*Sir F Bramwell.*

—— M. COLLADON, OF GENEVA, who has given considerable attention to the phenomena of thunderstorms, states, in a recent note to the Paris Academy of Sciences, that the present year has been exceptionally prolific in thunderstorms. He calls attention to the fact that, in 1868, there were also an unusual number of thunderstorms. In the present year he says that the number of lightning strokes, if we may so call them, which occasioned deaths and fires, far exceeded the average of the last twelve years in a portion of Europe, and Switzerland in particular. He thinks that physicists and meterologists ought in the cause of humanity to make it a duty to point out, whenever possible; the local causes which appear to them to have been the occasion of a fire caused by a lightning stroke, and to insist on such elementary precautions as might have prevented such a disaster. He then cites one or two remarkable instances of fires caused by lightning, and the probable reasons why the building was struck. In one case, on the 15th August last, at 1 A. M., a farm building was struck at Bourdigny, in the Canton of Geneva, and entirely destroyed; a second flash struck a poplar about eighty metres distant, while a third struck a vine a little further off. Only a short interval separated these flashes. He gives a drawing of the farm building in section. From this it appears that the lightning must have struck the iron roof, run down an iron stay rod inside the building, and then, finding no other conductor handy, jumped across to a large cistern of water, which was in connection with the earth by its supply pipes. In jumping across this distance the lightning fired the building. A portion of the flash, however, appears to have entered an iron wire stretching from this building to another, and to have killed a watch dog who was attached to this horizontal wire by a vertical wire and pulley, allowing him to run backwards and forwards across the yard. M. Colladon points out that had there been a continuous conductor from roof to earth, this building would have been saved. He remarks that metal is much in vogue now for building purposes, and that many houses and farm buildings are provided with cisterns of water, and are in much the same case as the building destroyed at Bourdigny. He recommends the erection of a continuous conductor, in order that lightning may go to earth instead of burning our houses about our ears. This advice has been given many times before, but how little it has been heeded is shown by our daily press every succeeding Summer.—London *Electrician.*

—— *L'Electricien* relates the following: One of the most eminent and old-established firms who supply incandescent lamps had lately fulfilled an order for a certain number of lamps, specified to be of twenty candle power at forty-five volts. They received, three days after despatching the goods, the following memorandum: "We have received your lamps as per invoice, together with the supports, but we were unable to find amongst the goods consigned the forty-five volts invoiced with the lamps . . . "!

TO THE PUBLIC.

Office of
THE ELECTRIC GAS LIGHTING CO.,
45 Milk Street,
BOSTON, Mass., Oct. 25, 1883.

NOTICE is hereby given that the contract heretofore existing between this company and The Electrical Supply Company of Ansonia, Conn., whereby the latter was licensed to manufacture and sell ELECTRIC GAS LIGHTING APPARATUS, under the patents owned by the former, was canceled by this company on the 20th day of September, 1883, for non-fulfillment and violation of its terms, conditions and covenants, on the part of said Electrical Supply Company.

Any manufacture or sale of said apparatus by said Electrical Supply Company, since the cancellation of said contract, is an infringement of the patents, and in violation of the rights of this company, and all parties who shall sell, purchase or use said apparatus, thus manufactured, will be held responsible. We have perfected arrangements for the prompt construction of the apparatus by manufacturing electricians who have had extended practical experience in this line of work, thus insuring the production of properly made and perfect working burners, which we shall supply to our agents and patrons in full confidence that they will give entire satisfaction.

We regret the interruption and delay which has been occasioned by the action of The Electrical Supply Company, but its failure to furnish the apparatus according to contract, and the small amount which it did furnish while said contract was in force, was so defective in construction and inferior in quality, that it became our imperative duty to ourselves and our patrons, to exercise our right to terminate the contract for breach of its conditions.

THE ELECTRIC GAS LIGHTING CO.,
by Louis W. Burnham, President & Business Manager.

BUSINESS NOTICES.

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ELGIN, Ill., Oct. 17, 1883.
Williams & Co., Publishers of The Electrician,
115 Nassau Street, New York.

GENTS—Herewith find draft as per your statement, October 1st, for advertising. We consider THE ELECTRICIAN the best medium of several with which we advertise. We are now filling a cash order of $60 which originally came from our advertisement in your paper in a foreign country. Wishing you success, I am

Yours truly,
WILLIAM HUBBARD,
for Elgin Telephone Co.

IMPORTANT PATENT SUITS.—Important suits have been entered in the United States District Court by A. L. Bogart, of No. 22 Union Square, against Mitchell, Vance & Co.; Chas. H. Hinds; Smith, Bridge & Co.; The Electrical Supply Co., and others. They are suits in equity for infringements of patents held by complainant, covering a frictional electric machine and electric gas burners, used in the lighting of gas jets in *multiple*, as well as every variety of apparatus and burners now in general use for lighting gas jets *singly* by electricity. If these patents are held to be valid, it will give the complainant a monopoly of the manufacture of these popular and valuable appliances in the United States.

E. & F. N. SPON have just issued a biographical sketch of Philipp Reis, inventor of the telephone; with documentary testimony, translations of the original papers of the inventor and contemporary publications. The volume is compiled by Sylvanus P. Thompson, Professor of Experimental Physics in University College, Bristol, who says in concluding the sketch "If mere mechanical imperfections do not make an invention any the less a true invention, it would be dishonest to deny to Philipp Reis the honor of the invention, of which he openly stated the successes and the imperfections." The volume is illustrated by explanatory engravings showing the original Reis telephones with all their details of construction. Copies of above, price $3.00, as well as any of the latest books on electricity, can be obtained at 35 Murray Street, New York, or will be sent free by mail on receipt of price.

REVIEWS.

ELECTRICITY IN THEORY AND PRACTICE, OR THE ELEMENTS OF ELECTRICAL ENGINEERING; by Lieut. Bradley A. Fiske, U. S. N., D. Van Nostrand. 265 pp. 8vo. 180 illustrations.

The design of this book is entirely novel. Lieut. Fiske has got out of the rut in which so many have been laboring, and has shown that it is possible for a writer on electricity, to combine theory and practice, and he has also shown by his clear explanations, that the theory of electricity, as applied to its practice, is not very difficult to understand.

His book is so arranged that a person wholly ignorant of the subject, can go step by step, from the most simple laws and applications, to the most intricate and complicated ones, so that he can then grasp the action and principle of any electrical machine or other mechanism by simply applying the principles there explained. The subjects of electrical units, electrical work, electrical horse-power, etc., which seem so abstruse and intangible to many, are here shown to be only simple matters of common sense; and the action of dynamos, motors, and other apparatus, is lucidly explained. The illustrations are numerous and comprehensive, and the style is so perspicuous that the effort of grasping the subject is reduced to a minimum.

Yet, though the book is intended mainly as a help to practical men and others, who desire to get a clear idea of the principles of electrical engineering, as well as its dry details, we think there are few advanced electricians who would not be interested and benefited by a perusal of some of the chapters, notably those on "The Electric Distribution of Power," and "Electric Railways."

To all who wish to inform themselves thoroughly upon the latest development of electrical engineering, we heartily recommend this admirable book.

ELECTRICAL MEASUREMENT, AND THE GALVANOMETER; ITS CONSTRUCTION AND USES; by T. D. Lockwood. 12mo. 137 pp. J. H. Bunnell & Co., New York.

This book is a desirable contribution to the growing number of works devoted to electricity, and is of especial value to those engaged in the practical applications of electricity. The subject is treated in a clear and concise manner, giving directions and rules for measurements by means of galvanometer and rheostat, without using any algebra.

The higher mathematics have their use in considering the problems of the more abstruse portions of electrical science, but we fully agree with the author in omitting them from a work designed for a guide in practical use.

The author calls attention to the fact that the applications of electricity form the only instance in modern construction, where careful measurements are not undertaken in designing any work. Accidents and luck form the history of early lines of telegraphy. The line constructed of wires of various gauge and quality; batteries either too large or too small; the relays of various resistances; and the whole plant forming a continuous disregard of fitness of means to ends.

The results of added experience, obtained by careful work under the guidance of books covering the field occupied by this manual, is reducing this empiricism, which has been in vogue in the applications of electricity.

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285,457	Electric Machines, Armature for Dynamo. C. F. Brush, Cleveland, Ohio.
285,527	Electric Machines, Device for Adjusting the Brushes of Dynamo. C. J. Van Depoele, Chicago, Ill.
285,547	Electric Motors, Armature for. C. E. Ball, Philadelphia, Pa.
285,682	Gas Lighting Burner, Electric. D. Rousseau, New York, N. Y.
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285,445	Lamp, Electric-arc. J. B. Tibbits, Hoosic, N. Y.
285,715	Lamp, Electric-arc. E. Weston, Newark, N. J.
285,494	Railway Rails, Electrical Connection for. W. W. Le Grande, Louisville, Ky.
285,714	Secondary Batteries, Apparatus for Charging and Discharging. E. Weston, Newark, N. J.
285,529	Secondary Battery. C. J. Van Depoele, Chicago, Ill.
285,709	Telegraph Printing. H. Van Hoevenbergh, Elizabeth, N. J.
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285,676	Thermostat, Electrical. F. H. Prentiss, and J. A. Tilden, Boston, Mass.

OCTOBER 2d.

286,100	Electric Alarms, Portable Circuit Closer for. A. Wiswall, Cincinnati, Ohio.
285,859	Electric Circuit Changer, Automatic. C. J. Van Depoele, Chicago, Ill.
286,158	Elecric Cut-off. J. A. Tupper, Salt Lake City, Utah.
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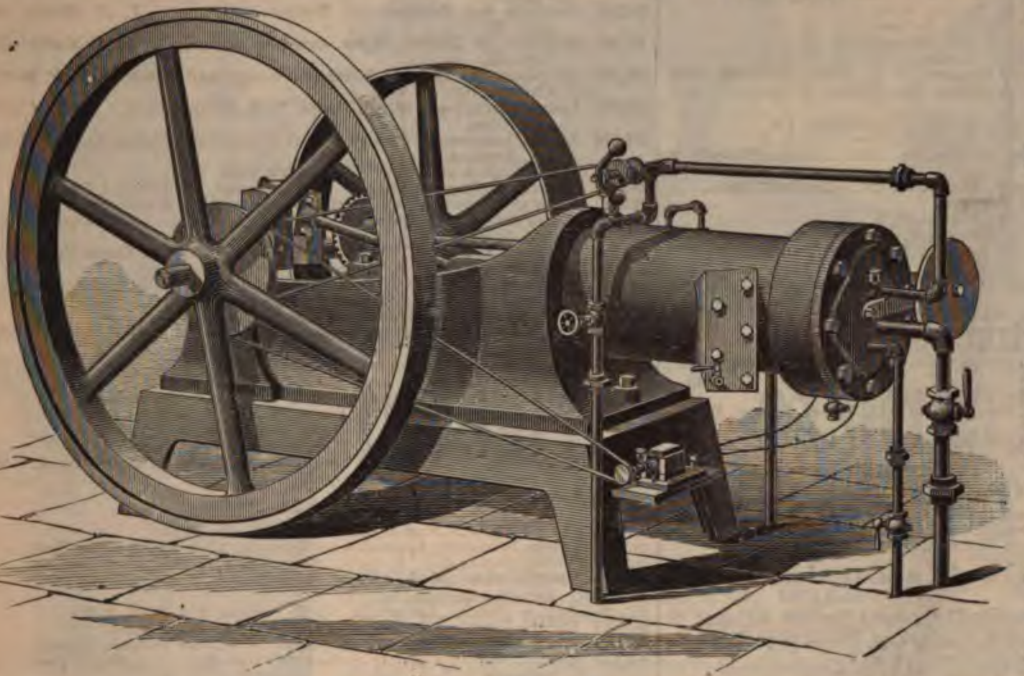

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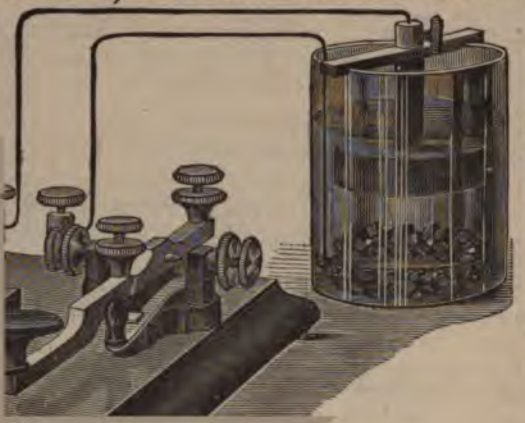

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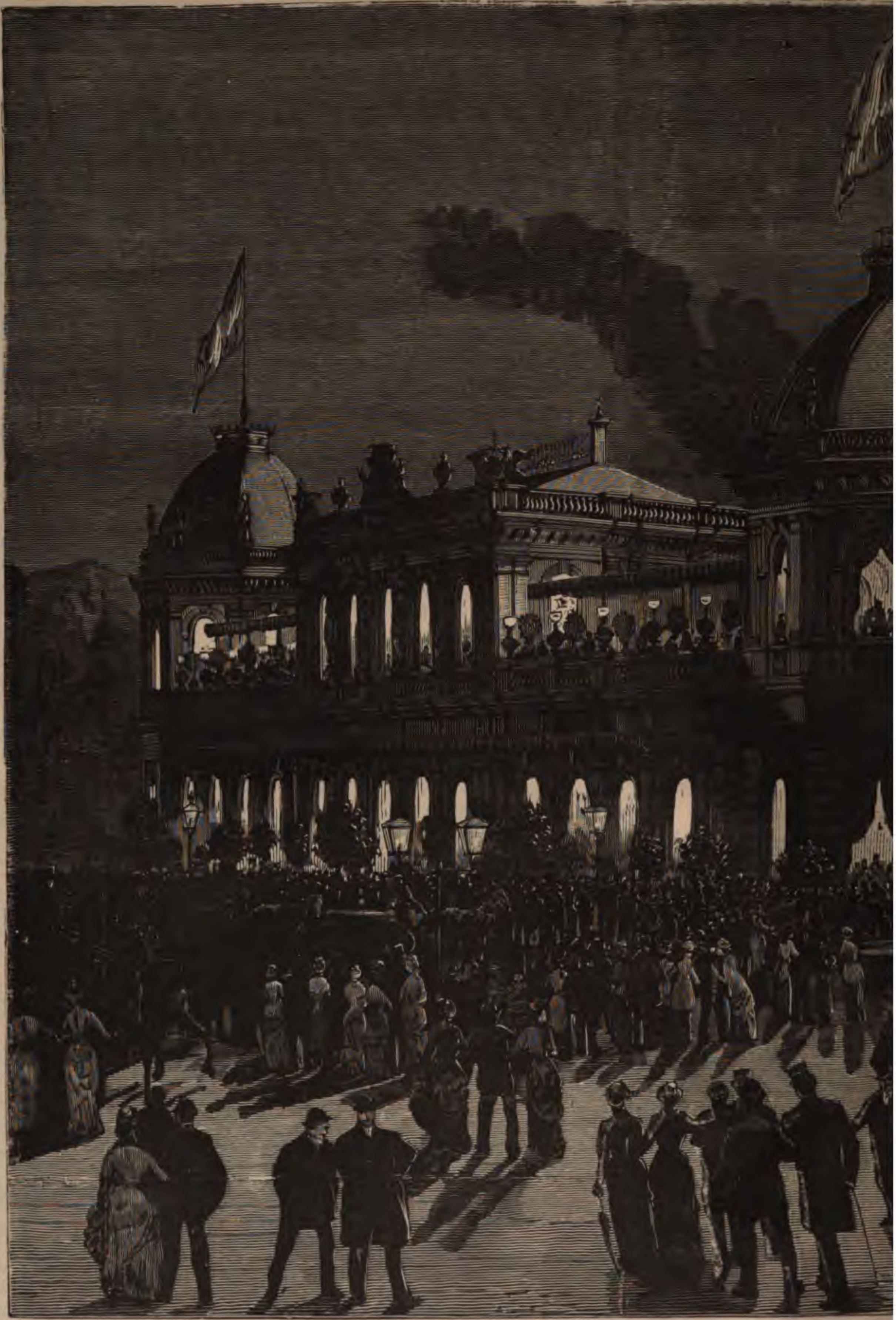
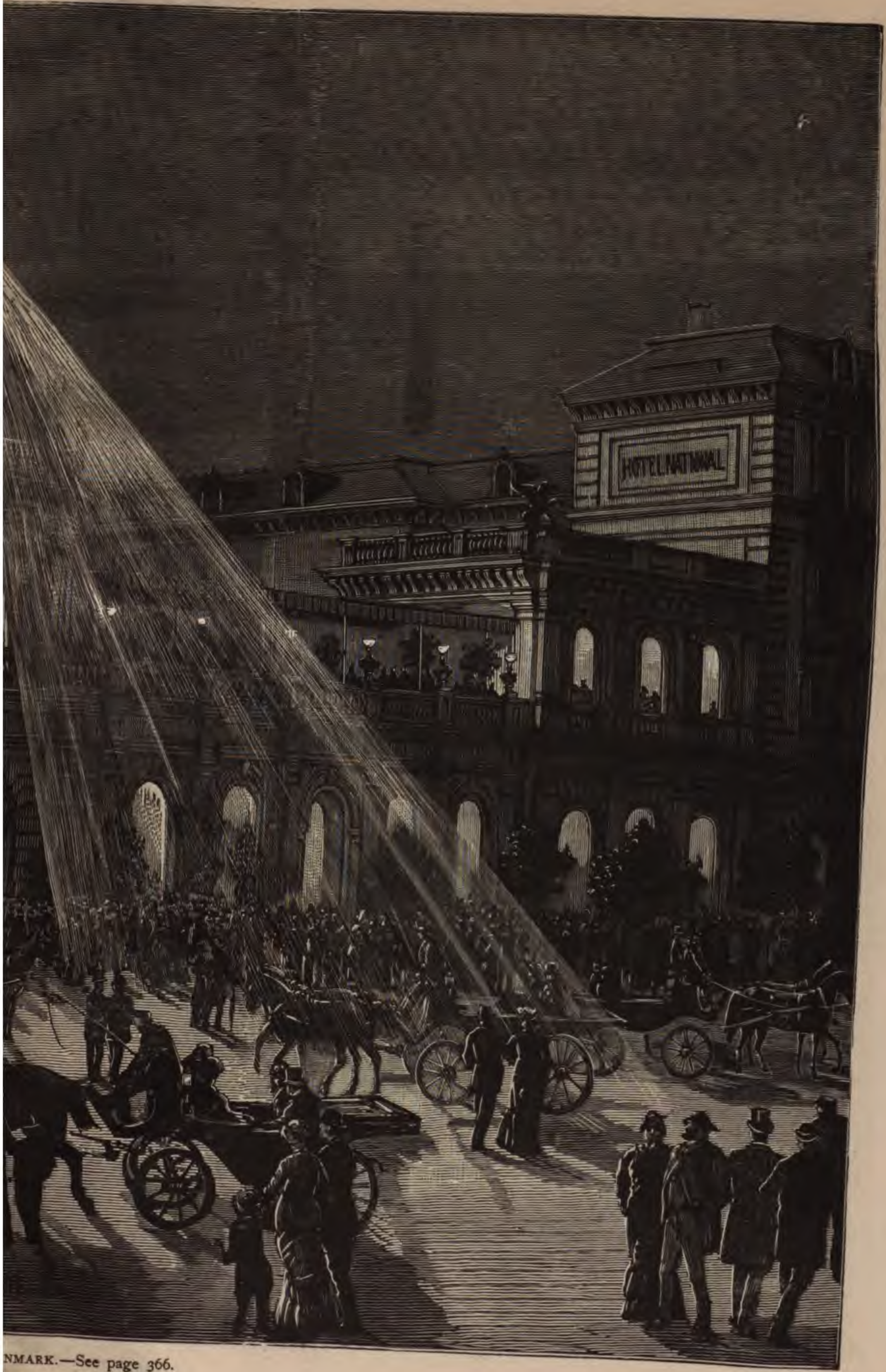


Electric Light Projector



NMARK.—See page 366.

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THE ELECTRICIAN.

Vol. II. No. 12.] DECEMBER, 1883. [$1.00 a Year. 10 Cents a Copy.

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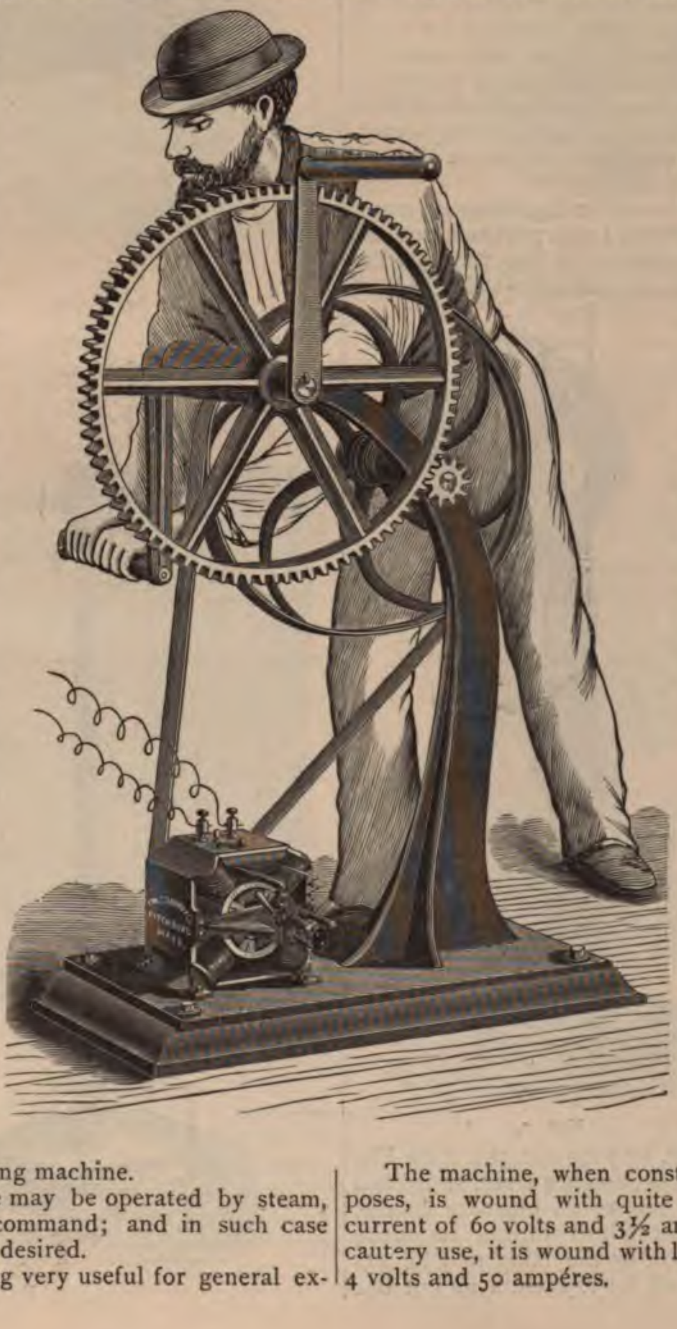
A NEW DYNAMO FOR EXPERIMENTING PURPOSES.

SINCE the introduction of electricity for illuminating, plating, and for the general uses to which it is now put, there has sprung up a considerable demand for a powerful and economical working dynamo for general experimenting.

A great many experiments, in which parties may be interested, and without doubt would perform if they had a powerful and economical source of electricity at hand, are not undertaken on account of the time, expense and trouble required to properly arrange a galvanic battery for working order. In this way they lose an opportunity of attaining the practical knowledge and enlarged experience to which such experimenting leads.



We illustrate a machine, made by I. W. Colburn & Co., of Fitchburg, Mass., which seems to fill a long desired want. The object was to produce a machine capable of developing a current of sufficient quantity and intensity to meet the demands of any laboratory, and one absolutely free from the defects common in other machines of this class.

These machines, we are informed, are more successful in their action, than the parties at first dared to hope for. With these machines the current can be perfectly regulated.

They furnish a current of sufficient power to operate three incandescent lamps, or one small arc light sufficiently strong for illustrative purposes. The machine requires about two man-power to operate it at its fullest capacity; but one man can develop sufficient electrical energy for general experimenting—the current developed being according to the power expended in operating machine.

When convenient, machine may be operated by steam, water, or any other power at command; and in such case it may be run continuously, if desired.

This machine, besides being very useful for general experimenting, is used to a considerable extent for practical purposes. A large number have been constructed for cautery use, and in every case are said to have given the best satisfaction.

With the use of this machine for cautery, a great deal of annoyance is avoided by the surgeon having the operation in charge. Will heat, white hot, a long piece of No. 16 platinum wire.

The machine is made very rigid, and runs perfectly even and free from noise, the gears being cut.

As will be seen, the machine rests upon a heavy and strong iron base, with an upright column all cast in one piece. The weight of base and column is 375 pounds. There are bolt holes in base for securing machine to floor. The machine is so speeded up, that with a slight exertion on part of person operating crank a very fast speed can be attained for the armature.

The machine can be run up to a speed of 1,800 revolutions per minute, and kept there without showing any heat in the armature or field coils.

The frame of machine is cast in one piece, and thus gives it absolute rigidness; besides the pole pieces of the exciting field are all secured to a solid composition ring, one on each side of poles. Machine is thus enabled to run perfectly free from vibration.

The armature is of the improved Gramme type. Current passes from armature coil through insulated wire in centre of shaft to the commutator, which is outside the bearings. This gives easy access to brushes, and they can be readily adjusted.

Unlike other machines, the commutator brushes, instead of being horizontally parallel, are set at an angle of 90° from each other.

The machine, when constructed for experimental purposes, is wound with quite small wire, and furnishes a current of 60 volts and 3½ ampéres; when constructed for cautery use, it is wound with large wire, and then develops 4 volts and 50 ampéres.

These machines are claimed to be useful for professors in schools and colleges, in illustrating the science of electricity; also to enable them to facilitate their researches in this line. With these machines all the experiments possible with a battery, and many for which a battery is unfit, may be successfully performed.

Very little space is occupied, and after first cost there is nothing to be figured as operating expenses, unless it is the interest on money invested in machines, and that is so slight, as not to be worth the reckoning. The first cost of the machine is a trifle more than that of a chemical battery of same power; but the cost of a battery after one month's use, would far exceed that of the dynamo; and the battery would be much out of repair, while the dynamo would be in perfect order.

SOME OF THE DEVICES OF M. G. TROUVÉ.

WHILE the establishment of systems of electric lighting from central stations has chiefly occupied the attention of electricians, some attempts have been made to devise appliances for the production and use of electricity for illuminating purposes in private residences, which have led to no extraordinary advance, but have certainly developed suggestions, which will eventually be more or less available.

M. G. Trouvé, of Paris, France, an ingenious inventor, has, among other matters, considered this problem, and the system of domestic lighting proposed by him requires the following devices, which are now in the market abroad.

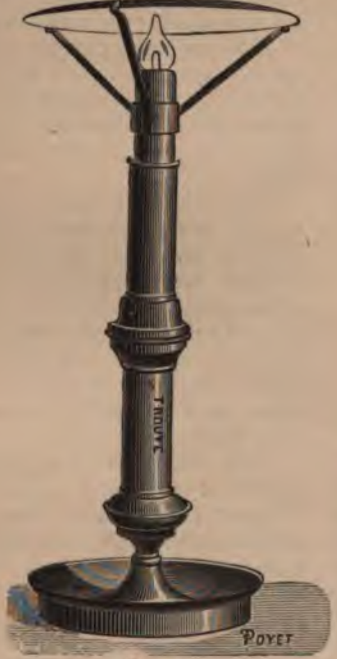


FIG. 1.

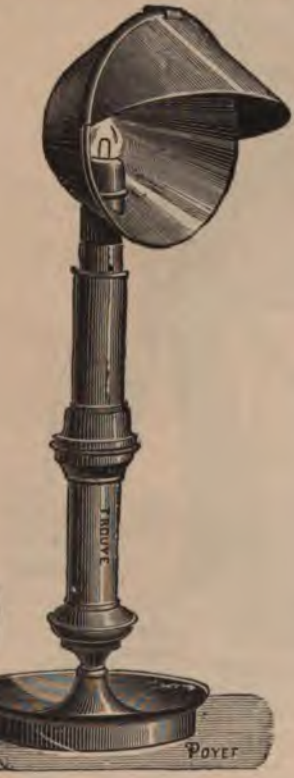


FIG. 2.

For a table or reading lamp, he proposes the form Fig. 1, which consists of a small incandescence lamp, supported on a plain column, about the size of an ordinary candle, and surmounted by a reflector which throws its entire light downwards upon the table; or the lamp may be enclosed in a hood, which cuts off its rays from all but one

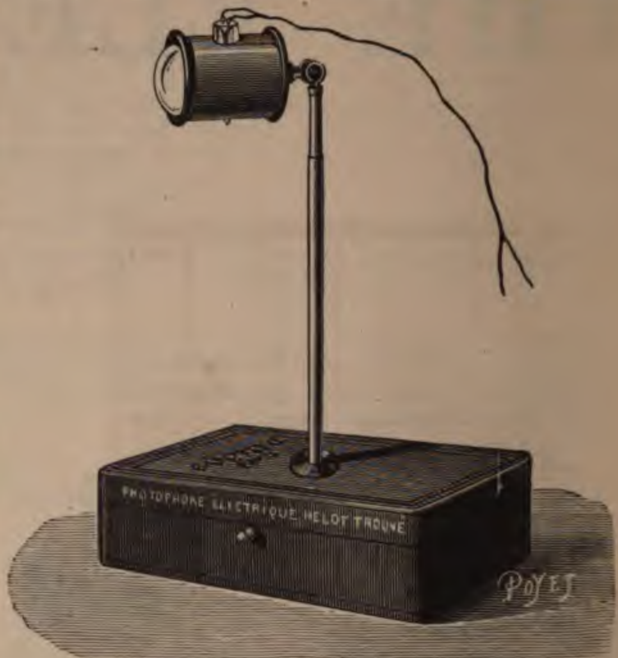


FIG. 3.

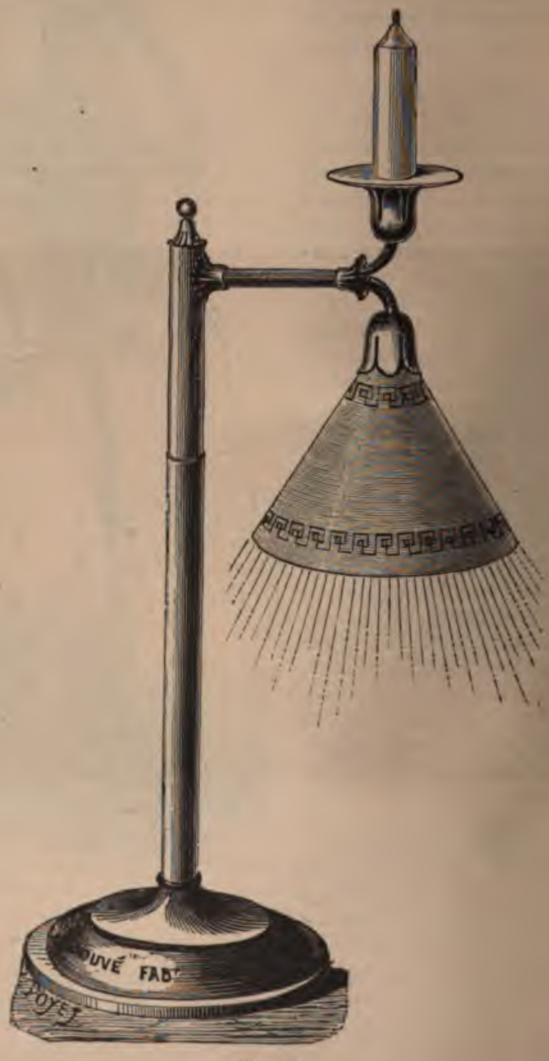


FIG. 4.

direction, as in the reading lamp, Fig. 2. A small lamp, throwing a very intense light in one direction only, may be formed by mounting the photophore[1] of M. Trouvé, as in Fig. 3; a more ornamental table lamp is shown in Fig. 4, which exhibits the combination of an ordinary candlestick and an incandescence lamp with an artistic design which adapts them for parlor use. These lamps are all of 12 candle power, and the pedestal is attached by an almost invisible, flexible wire cord, with the electric source. The candles supported by the latter forms, produce, when lighted simultaneously with the electric lights, a very agreeable mixed light, and when the lighting cable is detached, permit the use of the lamp as an ordinary chandelier.

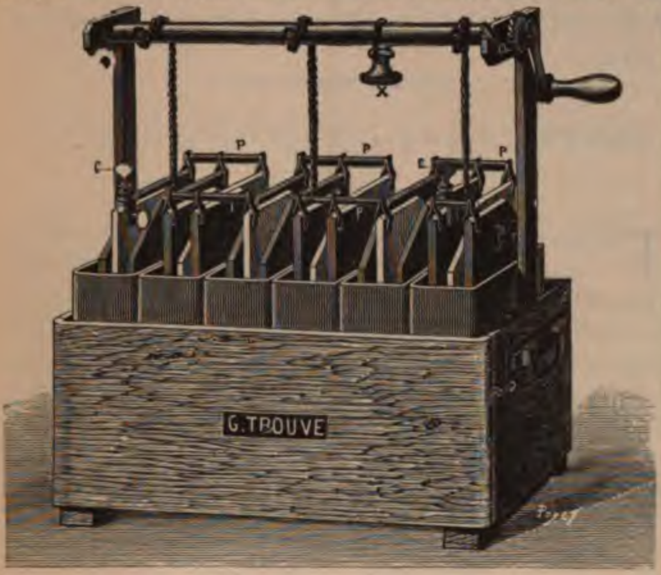


FIG. 5.

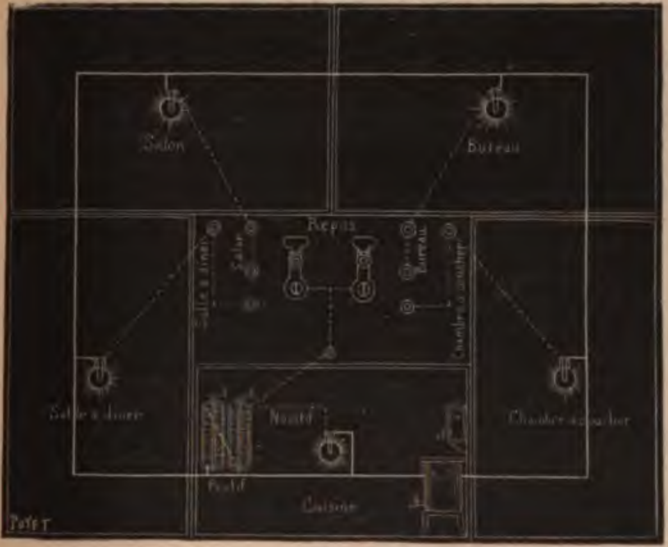


FIG. 6.

To supply electricity for these lamps an ordinary carbon and zinc plunge battery, Fig. 7, modified to suit its special application, and actuated by a solution of bi-chromate of potash in sulphuric acid, is employed. This may be situated in the kitchen, as represented in the plan Fig. 8, which has been successfully in operation for several months in a private house in Paris. From one of its poles is led a lighting cable as shown by the white line, which in the Fig. leads from and returns to the positive pole.

The negative conductor is represented by a dotted line which leads first to a lamp in the kitchen that is connected by an ordinary commutator. A special resistance coil associated with this lamp, permits it to be lighted without injury, even though all the others be abruptly extinguished. A branch of the negative conductor leads to a pair of handles which are situated in the middle of the commutator used to distribute the current to several apartments.

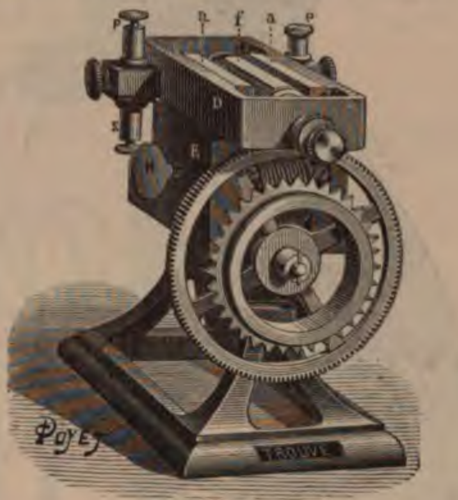


FIG. 7.

Various press buttons, each associated with its special lamp, may be thrown into circuit by this commutator, each separately or all together, as may be desired; and conveniently disposed reservoirs of stoneware, enable even an ordinary domestic to prepare the solutions and charge the battery without difficulty.

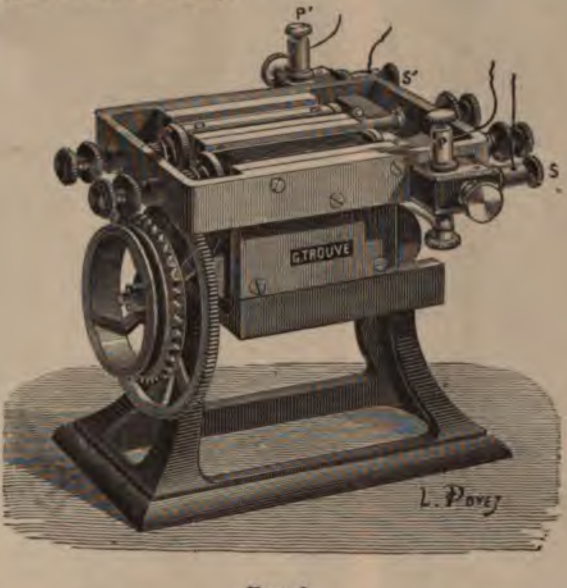


FIG. 8.

The battery above described is also adapted for use in connection with the system of electric navigation, devised by M. Trouvé. The motor employed in this system is shown in Fig. 7, and a modification, having double the power, in Fig. 8, and the remarkable feature of the system is that the motor is fixed upon the rudder of the vessel and drives a propeller, which also forms part of the rudder, as may be seen in Fig. 9. The batteries are located amidship, and may be two in number, driving a 2 bobbin motor, as in Fig. 10; 4 in number, driving a 4 bobbin motor as in Fig. 11.

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[1] Described in the ELECTRICAN, vol. 2, June, 1883.

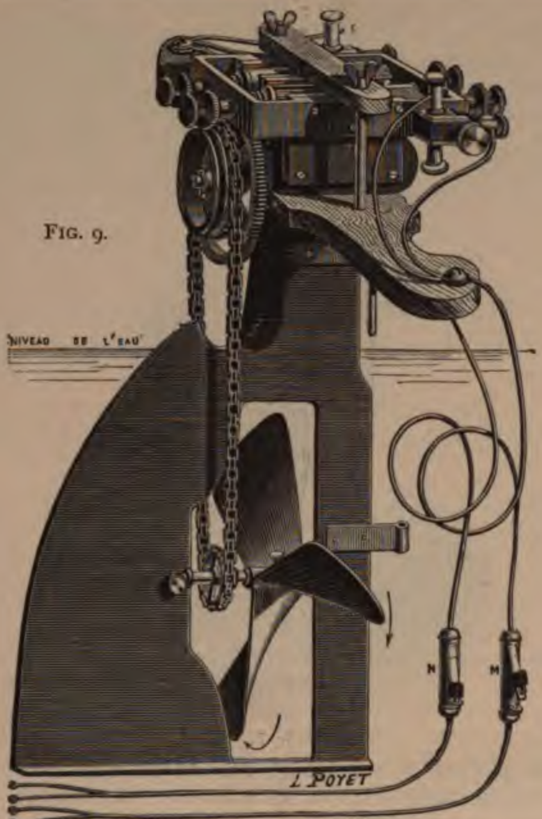
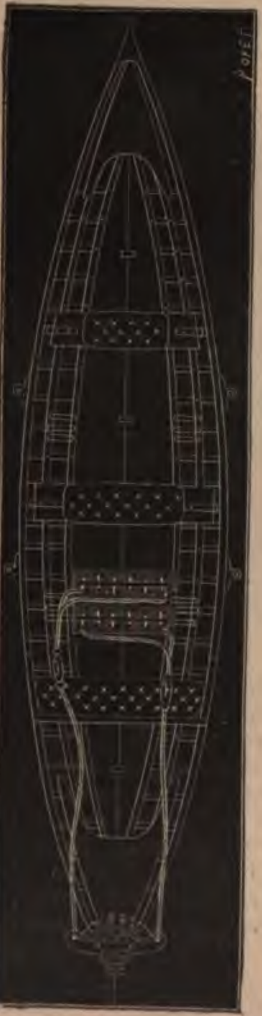


FIG. 9.



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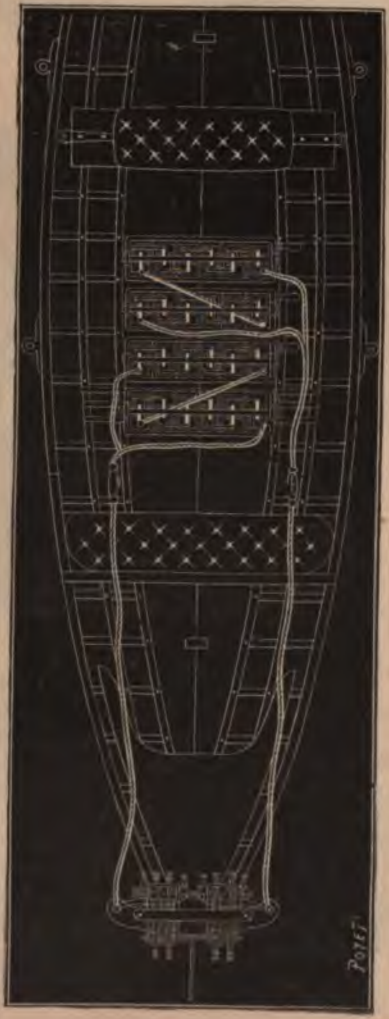


FIG. 11.

In either case the current is conducted to the motor by cables, which form part of the rudder cords, and the handles thereon, held by the pilot or cockswain contain commutators, by means of which the operation of the motor may be interrupted or reversed at pleasure. Hence, the system affords remarkable control over the movements of the boat. In fact, it may be turned about almost as if on a pivot.

ELECTRIC LIGHT PROJECTOR AT COPENHAGEN.

THE striking cut on our first page, for which we are indebted to *The Illustre vet Tidende*, of Copenhagen, represents a view of the "Cafe National" at Copenhagen, Denmark, lit up by the Maxim and Weston system. The plant consists of one Weston No. 5 10 arc light machine, one Weston 100 incandescent light machine, and one small Maxim machine for the projector. Besides the projector on the roof, there were 10 Weston arc lights, and 120 incandescent Maxim lights.

THE DYNAMO: HOW MADE AND HOW USED.

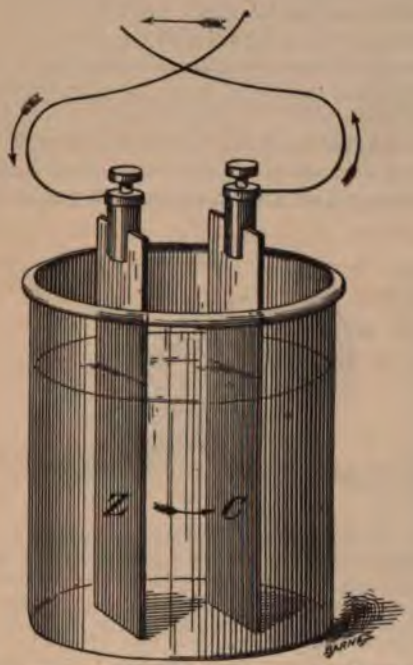
(*Continued from page 332.*)

§ 4. The student will do well to compare the effects produced on the galvanometer by the battery current, and by the current obtained from the magnet. Any single cell will do for this purpose; and in order to have an intelligent perception of what takes place, the student must bear in mind, that *in* the battery itself, the electricity (undulatory movement of the molecules) passes from the zinc to the negative plate (be it copper, silver, platinum, or graphite), while *outside* the battery, the electricity passes from this latter round through the wires, galvanometer, or other circuit open to its passage, back again to the zinc plate (see Fig. 4, where the direction of the undulation, or "current," is shown by the arrows; the plate marked *Z* being zinc, the one marked *C* being carbon, copper, or other conductor; *W W* being the wires forming the *poles* or *electrodes*). If the positive pole (the one from which the "current" is flowing, the wire attached to the *C* plate) of such a battery be connected to the galvanometer by means of the binding screw marked "over," the other pole being attached to the other binding screw, the North pole of the needle having previously been adjusted so as to lie between the two binding screws, it will be found that the N. pole of the needle will deflect to the *left* of the line of the coil; the operator being supposed to be standing at the binding-screw end of the galvanometer. Since the wire of our coil returns *below* the needle, it is evident that a positive current (an outflow of undulation) passing *over* the North pole of a horizontally suspended needle, or a negative current (an influx of undulation) passing *under* such a North pole, causes it to deflect to the *left*.

If we disconnect the battery, and reverse the connections, *id est*, join the negative pole (the wire coming from the zinc) to the binding screw marked "over," the other pole being connected to the other screw, the opposite effect results—viz., the North pole now deflects to the *right* of the coil. This will be understood by reference to Fig. 5, in which *a* represents the effect of the positive current flowing *from* the operator *over* the needle, the N. pole in both illustrations being nearest to him; in *b* the positive current is supposed to be flowing *from* the operator, *below* the needle, in either case returning to the battery the opposite way.

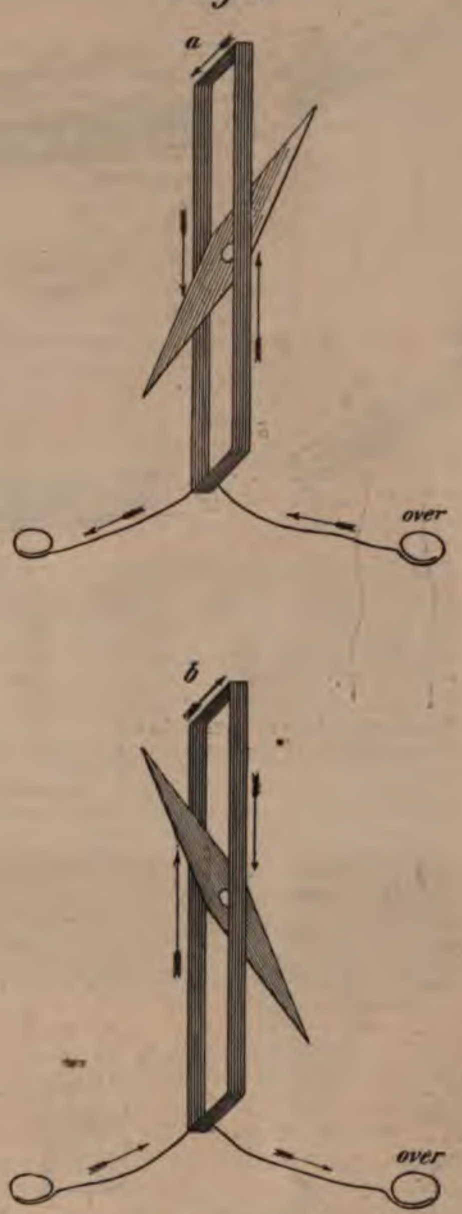
§ 5. This effect will enable us at once to recognize, by means of our galvanometer, the *direction* in which a current is traveling; for, on connecting the two terminals of any source of electricity to the binding screws of the galvanometer, whilst the N. pole is in a line with the coils, between the two binding screws, the operator facing the North pole of the needle, it is evident that if the N. pole of the needle is deflected to the *left*, the terminal attached to the binding screw marked "over" is *positive*; but that, if the N. pole deflects to the *right*, then the said terminal is *negative*. It must be borne in mind, that by the term *positive*, in this connection, is meant the point *from* which electricity is flowing, negative being the point *towards* which it is flowing, or *at* which it enters * This power of recognizing the direction of a current, will be found of great service to us in the construction of the dynamo.

Fig. 4.



§ 6. Returning, now, to our experiments with the magnet (see latter portion of § 3), and using, in preference, a straight soft iron rod, about 6 in. in length, and ½ in. in diameter, coiled with about 100 ft. of No. 24 covered wire, as our armature, and a good bar magnet to produce the electrical effects, we shall find, on coupling up the armature wires to the galvanometer, and approaching one end of the armature to or receding it from the N. pole of the magnet, that the electrical flow set up is always in one direction in approaching or making contact, and in the opposite direction on receding or breaking contact. Fig. 6 will make this clear. The arrow at *a* shows the direction of the current produced on approaching or making contact with the N. pole of a magnet; *b* illustrates the direction of current produced on receding from or breaking contact with the N. pole of a magnet. If now we reverse the experiment, by presenting the S. pole of the magnet to the coiled armature, we shall find that the direction of flow is also reversed; that is to say, the *withdrawal* of a South pole produces the same effect as the *approach* of a North pole, and *vice versa*, the *approach* of a South pole is equivalent in its effects to the *recession* of a North pole. It must be noted, that the direction in which the wire is coiled round the soft iron rod (or armature), while it has no influence on the direction of the electrical current set up round the iron rod (which is always the *reverse* to the hands of a clock in the face *approaching* the North pole) determines the extremity of the said wire at which the current leaves or enters the coil. In the Fig., we have supposed the wire to be wound from *left* OVER towards *right*; had we wound our rod from *left* UNDER towards *right*, the opposite ends of the wire would have been, respectively, + and —. This must be borne in mind when we proceed to actual work.

Fig. 5.



§ 7. *Currents can produce Magnetism.*—If we take the coiled soft-iron *U*, of which we made use, § 3, and apply it to pieces of soft iron, nails, filings, etc, we shall find that it possesses little or no magnetic power of attraction; but if we couple the projecting ends of the coiled wires, one to each terminal of a single cell battery, we shall find that the *U* will become powerfully magnetic, retaining its magnetism as long as electricity flows around the coils, but losing nearly all the instant that the flow is caused to cease, either by breaking connection with the battery, or by any other interruption. The rapidity and completeness with which the iron loses its magnetism, depends almost entirely on its *softness* and *purity*. Anything which tends to put a strain on the molecules of the iron—such as hammering, filing, twisting, sudden cooling, vibration, etc., —render it liable to retain magnetism, or increase its *coercitive* force; whereas, raising to a high temperature and very gradual cooling, which allows the molecules to range themselves with little or no strain, furnishes a soft iron, eminently incapable of retaining magnetism, or possessing little *coercitive* force.

§ 8. The direction in which the flow of electricity takes place around the iron bar decides which end of the bar acquires *North seeking*, and which *South seeking* polarity. Let us suppose, as in Fig. 7, *A*, that one extremity of the bar be made to face us, and that the current be caused

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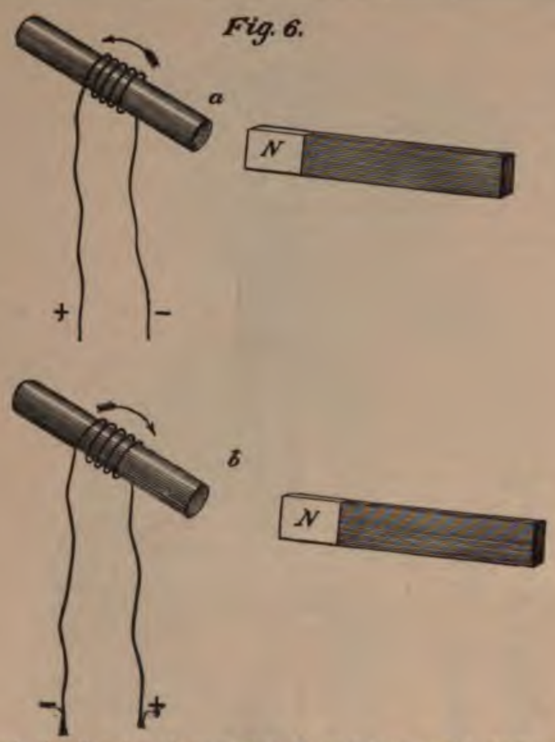
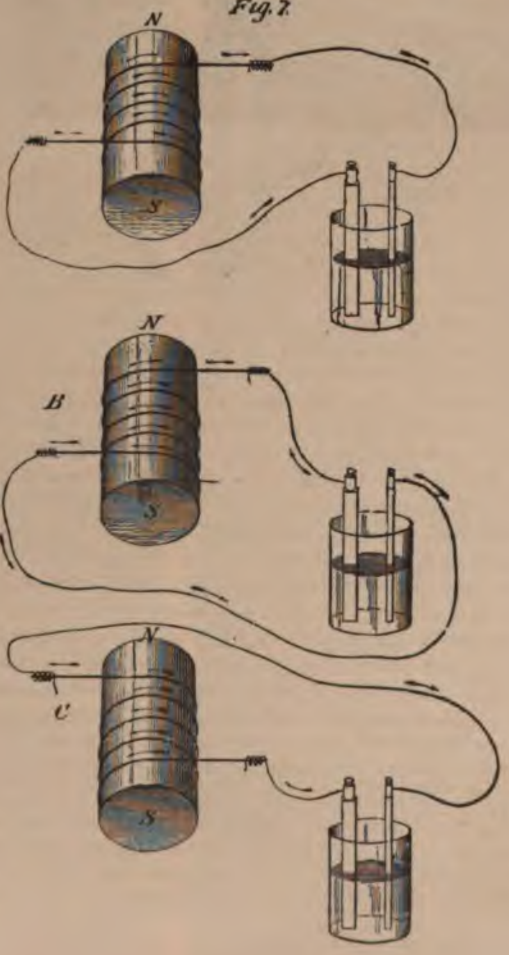
* We have no desire to enter into any theoretical matters in these papers; but comparing electricity to sound, we may say, that in blowing a blast in a trumpet, the trumpet may be considered as *positive*, while the ear of the listener may be considered as being negative. The chief difference seems to be, that electrical undulations seem to require a complete circuit wherein to display their effects—sound undulations being bound by no such conditions.

Fig. 6.



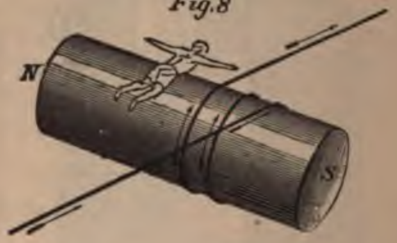
to flow in the direction of the motion of the hands of the clock; in this case, the farther extremity of the bar becomes a *North seeking* pole, while the nearer extremity becomes *South seeking*. The direction of the current, and consequently the polarity of the bar, may be reversed by joining up the *opposite* electrodes of the battery (or other source of electricity) to the ends of the wire coiled round the bar, as shown at *B;* where, as the wire s joined to the electrodes in a manner just the reverse to that shown at *A*, so also the current enters at the opposite end of the wire, and produces contrary magnetic effects. The same result may also be attained by coiling the wire around the bar in the contrary direction, while leaving the connection with the electrodes unchanged, as represented at *C*. Perhaps the simplest means of remembering the relation which exists between the direction of the current, and the position of the magnetic poles produced, is one known as "Ampére's rule," in which the experimenter considers himself to be swimming head foremost, *with* the current, along the wire, *always facing* the iron core; *then* the *North seeking pole* wil] always be at his *left hand*, see Fig. 8.

Fig. 7.



§ 9. It must be borne in mind, as being of the greatest importance in the construction of successful dynamos, that although *steel*, or hard iron, when subjected to this inducing action of the current, becomes *magnetic*, yet it does not acquire nearly such powerful magnetism as soft iron; and, in fact, the softness of the iron, and its capacity for becoming powerfully magnetic, run side by side. On the other hand, it must not be forgotten as we learnt at § 7, that the softer the iron the sooner it loses the magnetism imparted to it; while the harder brands of iron (and more especially steel), retain nearly all the magnetism which it is possible to confer upon them.

Fig. 8



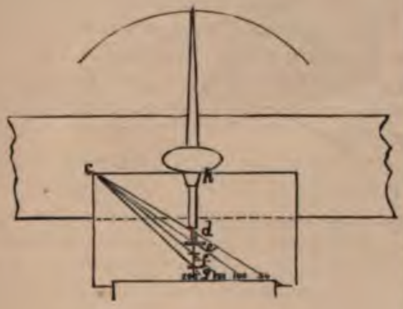
§ 10. The student who has carefully and intelligently performed the experiments described in the previous sections, will now find himself in a position to understand the principles which underlie the construction of the dynamo, even though he may have little or no previous knowledge of electricity. The first machine constructed after Faraday's discovery, was that of H. Pixii, in 1832. In this machine a powerful horseshoe magnet was caused to rotate rapidly before a soft iron *U* piece, wound with insulated copper wire, the two extremities of which were prolonged by two brass springs pressing against a rotating split collar of brass, whose office was to rectify the direction of the currents produced by rotation of the magnet, before the iron core; currents which, as we have seen in § 4, are in different directions, according to whether a given pole of a magnet is *approaching* to or *receding* from the core. This arrangement for causing alternating currents to flow in one direction, is known as the *commutator*, and it, or some modification of it, is most extensively used in all dynamos in which it is of importance that the current should flow in one direction only. The chief disadvantage in this machine was that of having to rotate a heavy magnet (built up of a number of thin steel plates), since the mere rotatión tended to destroy, or at all events, to weaken its magnetism. In 1833 Mr. Saxton had the happy idea of fixing the heavier and causing the lighter portions of the apparatus to rotate; in other words, the magnet (or magnets) was now made a fixture, while the U-shaped soft iron armature, with its surrounding coils of wire, was caused to rotate rapidly before it, on axis or spindle, either by gear wheels or wheel and band. Mr. E. M. Clarke, in 1834, noticed that the *thickness* of the wire coiled round the armature had a considerable influence on the nature of the current produced by these machines. If the wire employed be very thin, say about the $\frac{1}{100}$th of an inch in diameter, and a large number of convolutions be coiled around the legs of the armature, the electricity produced is of high *tension*, capable of overcoming considerable resistances, and of giving severe shocks. If, on the contrary, a smaller quantity of a much thicker wire, say from the $\frac{1}{14}$ to the $\frac{1}{18}$ of an inch be made use of, the current produced is that known as a *quantity current*, or a "large" current, possessing but little power of overcoming resistances, not capable of giving shocks, but giving fine large sparks, and able to decompose water, and other chemical bodies. Clarke usually furnished two armatures with his machines, one wound with about 1,500 yards of covered wire $\frac{1}{96}$ in. in diameter, which he designated the "intensity" armature; the other, wound with about 40 yards of wire $\frac{1}{18}$ of an inch thick, to which he gave the name of the "quantity" armature. One peculiarity of the machines turned out by Clarke was the fact of the rotating U-shaped armature, being made to rotate near the flat *sides* of the magnet instead of *in front* of the poles. This, though it facilitates somewhat the mechanical arrangements, is open to some objections on the score of lesser efficiency, since the most active portion of the magnet is certainly *in front* of the poles.

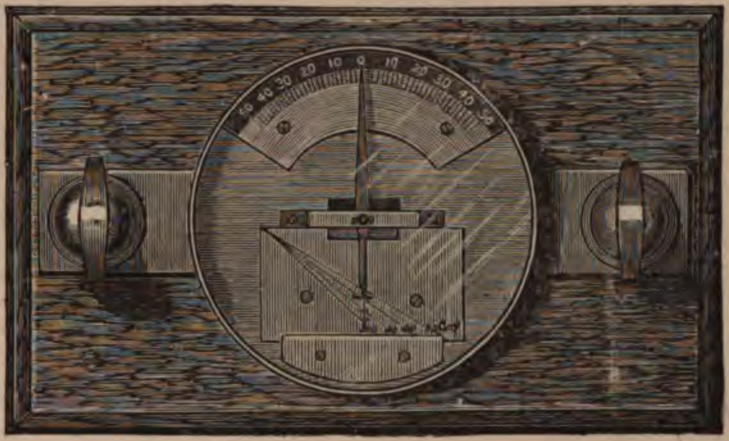
PATTERSON'S "ENGINE ROOM" AMMETER.

THIS galvanometer is designed as a cheap and effective current indicator for electric light installations for currents of five to 500 ampéres.

Instead of a coil of wire, a plain strip of 1x⅛ copper is used. The needle is short and oval, and it is found that the deflection of the pointer is exactly proportional to the current, excepting for the first degree or two above zero.

The pointer is counterbalanced by an arm capable of being lengthened or shortened. If the arm is shortened to its full extent, so that the pointer is very nearly balanced, a position may be found for the index so that a current of 50 ampéres will just mark 50 degrees on the scale. At its full extent it may take 200 ampéres or more to throw the pointer over to 50 degrees. And similarly, positions may be found where 100 or 150 ampéres will deflect the pointer to 50 degrees It is, therefore, only necessary to multiply the reading by 2, 3 or 4 in these respective cases. The limit of increase of the constant is the carrying capacity of the copper band.





The instrument is thus easily adjustable to serve for small or large currents. To show the amount to which the counterpoise has to be lengthened or shortened, a transparent vernier is provided, ruled on the lines going from a point, *c*, through the various points, *d, e, f, g*, where the index has to be to give the above readings. The intersections of these lines with the perpendicular, *h, g*, forms points on which the knife-edge of the index must rest.

If, however, the needle should lose its power in time (as all permanent magnets do), and it is desired to recalibrate the instrument, all that is necessary is to pass a known current of (say) 45 ampéres through it, and to shift the index of the counterpoise till the pointer rests at 45. The horn vernier or scale will then have to be shifted slightly to the right or the left till the point of intersection, of *c, d*, and the perpendiculars, *h, g*, is exactly under the new position of the index. The instrument is now in a position to take correct readings of small or large currents, as the new points of intersection on the vernier bear the same relation to one another in position as before.

The *London Electrical Review* states, that what is claimed for the instrument is:

1. Universality, in that it is serviceable for small or large currents.
2. Facility for taking readings, they being the same as the degrees on the scale or a multiple of them.
3. Easy calibration.
4. Simplicity of construction, which means a reasonable selling price.

We are informed that this apparatus is made by Messrs. Patterson & Cooper, of London, and adapted for any currents up to 2,000 ampéres, and that it is sold in England at £3 3s.

ELECTRIC LIGHTING.

OUR attention has been called to our article of last week by more than one party who consider that our remarks were somewhat severe. We believe we are entirely justified to the fullest extent in our remarks. We also believe that some of the advertising which is being done by parties in the city of Boston, to-day, is but little more creditable in actual effect than was that of Berney's Globe Company, which was so successfully squelched not many months ago. We have no intention of making any comparisons which are not just, and while we stated only the case that Edison had not done certain things we do not know that the New England, Weston or the Brush people have lent themselves to any such swindles as are now being perpetrated. We believe that there are gigantic frauds now in progress, and their home is in Boston. We referred to the Providence station last week as being closed up, while brilliant representations had been made of its opening, but the fact had not been stated that no lamps existed outside of the station. We also learn that the Springfield scheme has fallen through, parties there not desiring to go into stock speculation or to be manipulated. The daily press are still advertising a new company which is to be established pretty near our office, and we will further say, that when the United States Government can hire all the money they want, at 3½ per cent. we should look with distrust upon any concern, individual, corporation, bank, or otherwise, who attempted to advertise that they can make a dividend of ten per cent. upon a legitimate investment with legitimate management.

We have often said that large dividends, high rates of interest, big shaves on discounted paper, invariably meant poor security. We do not believe that the electric lighting company, now being advertised, can accomplish anything like the results they propose, and we believe, if the matter is closely investigated, it would be found to rest not upon substantial argument but rather upon stock manipulation. More than this we cannot at the moment say; but we will say that if the daily papers should pay half the attention to investigating and saving parties from being swindled that they did to the disgraceful hurrah which has just ended, they would certainly raise their tone and character as public journals rather than private corporations for sponging money, and would certainly save widows, children, and many people of small means from being swindled by men with an infamous history and a record which is, not by any means A1. Instead of this all of our daily papers are lending themselves to advertise a scheme which we believe will, if investigated, prove to have no foundation in fact as they are representing it. Electric lighting has not been a commercial success, with some exceptions. No company in Boston has made money to pay dividends from their earnings; it has been a cut-throat business for the last year and a half, and we do strenuously urge our readers to keep clear of these glowing advertisements, and let alone buying stock where the name of other people is used as having invested, without making the most diligent research into all the facts surrounding the case, and looking most closely into the actual status of the affair, from some other source of information rather than the parties who are manipulating the scheme.—*Cotton, Wool and Iron*, Nov. 17th.

NEW YORK ELECTRICAL SOCIETY.

THE meeting of the New York Electrical Society, on Friday evening, November 16th, was well attended, and included a goodly number of persons prominent in various branches of the science of electricity.

After the transaction of routine business, the lecturer of the evening, Mr. S. P. Frier, manager of the Wheatstone Department of the Western Union Operating Room, was introduced, and read a very interesting paper on the "Wheatstone System of Automatic Telegraphy."

Mr. Frier began his subject with a brief sketch of all the automatic systems which have been and are now in use by the various telegraph corporations. Bain's system, which was invented in the year 1846, was the foundation of successive systems—good, bad and indifferent. This system was experimentally tried in this country in 1848–'49, but was abandoned for various reasons. An Austrian, Dr. Gintl, followed Bain with a system somewhat similar. In 1853 Siemens and Halske, of Berlin, bought an automatic process, and equipped lines in Russia with it. It was subsequently superseded by the Morse system. The difficulties encountered in this system, led to the introduction of the Siemens' polarized relay. This firm and others made innumerable experiments in automatic telegraphy, but not until the advent of the Wheatstone system was anything of a reliable nature produced.

"It was during a visit to Paris," said the speaker, "that, in watching the performance of a Jacquard loom (in which the threads are controlled by perforated paper cards), it occurred to Sir Charles Wheatstone, that if the mechanism of a loom could be so regulated, why not electricity? This idea," continued the speaker, "was immediately worked out, and in 1858 he took out his first patent for what is now so well known as the 'Wheatstone system.'"

Its working parts consist of a perforator, in which the paper is prepared for the transmitter; the transmitter, which uses the perforated paper for the purpose of transmitting the currents of electricity, and the receiver for recording upon paper the results of such electrical transmissions.

The speaker then described in detail each instrument, using diagrams to illustrate special parts of the mechanism not well understood by a mere verbal description.

The development of the Wheatstone system in Great Britain and Ireland during the past five or seven years, has been the most rapid of any system, and now all the circuits are worked at an average speed of 200 words per minute. It is growing in favor on the Continent. The Minister in Postal Telegraphy in France, has established at the central office a special course of lectures on Wheatstone's automatic apparatus, to which competent operators are admitted.

"One of the great uses to which this system is particularly valuable," said Mr. Frier, "is that of working extremely long wires. Experiments are at present carried on in working the system duplex, on a wire 1,000 miles long, through one repeater, and the speed attained is an average of nearly 150 words per minute—an equivalent to 600 messages per hour, 30 words per message. It is just a question of time when it will be working quadruplex. Like all other systems, that have for their object the disposal of many messages over one wire, the Wheatstone requires skilfull handling, and the repeaters have to be under the control of experienced electricians to obtain their full working capacity. A skilled mechanician is also an importatant requisition in this system. The Western Union have in their employ one of the best they could get from England. Another great advantage of the system is, that the paper for receiving does not require any preparation after leaving the hands of the manufacturer."

In conclusion Mr. Frier stated, that every town in England, which has a morning newspaper, has a Wheatstone circuit. London is the fountain head of the service, and an average of one million words per night are handled here. One punched slip will feed as many transmitters as necessary. These slips are often punched at once by the perforator, thus supplying matter for three separate wires.

There is no political, congressional, or other public meeting that has not a trained staff of Wheatstone operators. Every race meeting has its Wheatstone staff, without which, at such places as Epsom, Lincoln, Newmarket, etc., the business could not be handled—at the former on Derby Day, 5,000 or more despatches are handled within an hour or so of the result of the race.

A complete set of the apparatus, which had been placed on the platform for the occasion, was then put in actual working order, and examined with evident satisfaction and pleasure by the members. The scene was a lively one for a time, resembling a junior telegraph office. The beautiful workmanship displayed in the finish of the instruments elicited general expressions of admiration.

The next meeting of the Society will be held on Friday evening, December 7th, at which Mr. P. B. Delany, of Philadelphia, will deliver a lecture on "Synchronous Multiplex Telegraphy." This is the system recently invented by that gentleman, and given much publicity through the daily press.

RELATIVE COST OF THE ELECTRIC LIGHT.

THE following letter gives some information of interest relative to the cost of lighting mills with the incandescent system of electric lights:

OLNEYVILLE, R. I., Oct. 20, 1883.

Messrs. Rhode Island Electric Lighting Co., Providence:

GENTLEMEN—In accordance with your request, we give you below the result of our experience with the Maxim incandescent light.

On the third day of April last, we started one of your Weston dynamos, running one hundred Maxim incandescent lamps, and April 30th, an additional fifty-light machine. Our shop is a one story weave shed, containing 260 cotton looms, with attachments for fancy and Jacquard weaving, running on white work day and night, an average of 280 hours per month of lighting time throughout the year, or 243½ hours per month for the season just passed.

The power is furnished by the Corliss engine which drives our looms, our indicated H. P. being 50 without electric machines, and 73 H. P. with machines running. The shop was piped for gas with one seven-foot burner to every two looms, and additional burners in other parts of the shop, 167 in all. In stringing for electric lights we hung one incandescent lamp beside each gas burner, thus displacing only one gas jet by an electric lamp. The lamps were guaranteed for an average life of 600 hours. Since putting in the Weston machines we have run our 167 lamps every night, burning gas only during the stoppage of engine at midnight and morning, say a dozen burners one hour a day. We average the time of starting the two machines at April 15th, and reckon a full six months' average operation of the same—to October 15th—1,460 hours, the result of which is as follows:

Lamps broken in April.	9	Lamps broken in August	10
" " May	8	" " Sept	9
" " June	7	" " to Oct. 15	8
" " July	9	Total	60

exclusive of 20 which were broken in starting the machines prior to April 3d, and 7 imperfect lamps which burned only an hour or two, and were returned for new ones. The time so far run is, in our judgment, too short to admit of an exact calculation of the actual life of the lamps. A breakage of 10 per month as above, if continued indefinitely in the future, would indicate an average life of nearly 17 months, say 4,000 hours. This we do not expect, but think we are safe in counting upon an average breakage of not over 18 per month of 243 hours, giving a life of 9 months or 2,200 hours.

Assuming the life of the lamps as 2,200 hours, we have as the cost of lamps per year of 3 360 hours, an equivalent of 255 lamps, at $1.50 each	$382 50
Attendance, 4 men, at $9.00 per week	468 00
Fifteen per cent. on cost of machines, shafting, belts, etc., ($4,328.00)	649 20
Oil, brushes and sundry supplies, estimated	130 00
23 H. P., at 1 $\frac{25}{100}$ cents per H. P. per hour, for 3,360 hours	966 00
	$2,595 70

Cost of gas, 167 seven-feet burners, 3,360 hours, 3,927,840 feet gas, at $2 per M......................	$7,855 68
In Providence we should be allowed a rebate on this quantity of gas, say 25 cents per thousand feet.	
Cost of electric lighting $\frac{46}{100}$ of 1 cent per lamp per hour, equivalent to gas at 66 cents per thousand feet.	

In the above figures we have charged to interest account an excessive amount, intended to cover depreciation and breakage. Up to this date we have had no breakage, and the machines are in better running order than when first put in. We have also charged to power the full proportion of the 23 H. P. used. We think it fair, however, to reckon against electric light only the expense of power in excess of what it was costing us before using the electric machines; inasmuch as we had our engine and boiler plant and the expense of engineers, supplies, interest, and the larger part of the fuel while using only 50 H. P. As most manufacturers are in the same position, the actual cost of adding electric machines to an existing plant of machinery would be, as regards power, much less than the proportion of H. P. added.

In our case we estimate the difference of cost per annum at not over	$500 00
Adding this to attendance, lamps and supplies as above..	980 50
And 6 per cent. for interest on plant	259 68
We have...............................$1,740 18	
which may be regarded as the actual cost per annum to us so far.	
To this should be added a depreciation account, say of 8 per cent., or.............................	346 24
Or a total of...........................$2,086 42	

which we believe to be a close estimate of the cost to us of 167 lamps, running or burning 3,360 hours per year, or 3/8 cents per lamp per hour, equivalent to gas at 53 cents per thousand feet.

The cost of several of the above items could be reduced largely by mills using larger engines and more electric machines. For instance the cost of power, in our case 1 1/4 cent per H. P. per hour, should be brought to less than 1 cent, while one attendant at, say $2.00 per night, could run 6 electric machines instead of 2 as in our case. The cost of machines, lamps and supplies will probably be reduced by competition as well as by improvements in the manufacture of the same, and there will doubtless be an increase in the actual duration of incandescent lamps.

We think it fair to state that we have a short circuit and a favorable one, with the dynamos placed in the same room with the lamps, and an easy load on our engine. Our running nights is also calculated to reduce the cost of the electric light to us. Our shop, however, is, on the whole, not an easy one to light, owing to the fancy heads on our looms and the heavy framework overhead for Jacquard attachments. We were obliged, in consequence, to use a large number of lamps for the area lighted, and the test against a seven-foot gas jet was a severe one for the electric lamps. We have had for six months a perfectly satisfactory light, with little trouble from any source; and as machines in actual operation every night during this time, we have no hesitation in saying that your Weston dynamos, with the Maxim lamps, have passed beyond the experimental stage and seem to us an assured success. We remain,

Very truly yours,

GRANT BROTHERS.

—— AN INDIANAPOLIS INVENTOR is said to be quietly laboring to perfect an electric headlight for locomotives, the power of which is to be equal to that of 400 candles. As a 20-candle light is the most intense that has hitherto been devised for this purpose, the prodigious gain of the invention, should it prove successful, is quite incalculable. It will light the track for a mile brilliantly, and the light will be full and continuous.—*Western Manufacturer.*

ELECTRICAL DISTANCE AND SPEED INDICATOR.

WE learn that the electrical mileage and speed indicators, manufactured by the Electrical Mileage and Speed Indicator Company, of Detroit, Mich., under patents owned by Mr. E. R. E. COWELL, of the same city, have been thoroughly tested on the Michigan Central Railroad with most satisfactory results.

The mileage indicator takes its motion from a magnet connected with the revolving axle by a simple cast-iron commutator and wires. As 480 revolutions of the forty-two-wheel, and 610 of the thirty-three-wheel make a mile, an exact measurement is made easily. The device is very simple but effective. Tested over a ten thousand mile run, not one mile was lost.

An electric signal, coupled automatically throughout the train, is another of Mr. Cowell's inventions, manufactured by the company above named. It is intended to supersede the bell-rope with its many imperfections and shortcomings, and has been aptly described as "the bell-rope of the future." No matter what the length of the train, it gives a perfect and instantaneous signal to the engine driver.

—— IT MAY CERTAINLY be said that for pumping, sawing, and such like operations of a large country house, an electro-motor, actuated by the dynamo which lit the house at night, would be much cheaper and quite as effective as a steam engine. Sir William Armstrong, at his place near Newcastle, has utilized a waterfall in his grounds to light his house by night, and supply it with power by day. The waterfall is 1,500 yards from the house, it actuates a turbine which it connects by a belt to a dynamo electric converter, capable of transmitting about five horse-power into a current of electricity. The current is conveyed by a suitable conductor to the house, where it works forty Swan lamps. In the daytime it works a sawmill. Sir William Siemens, at his country seat, near Tunbridge Wells, uses a steam engine, the waste steam of which warms the hot-houses. During the night the primary machines actuate two powerful electric lights, which are employed in forcing the growth of various fruits and plants which live, as it were, in perpetual sunlight—or its equivalent! During daylight one of the machines is used to work a chaff-cutter and other machines at the farm, a quarter of a mile away; the other does the pumping of the establishment. At night, of course, they are employed for light.—*Nineteenth Century.*

—— A DESPATCH FROM BOSTON, Nov. 17, says: Suit has been entered in the United States Circuit Court here by the Western Union Telegraph Company, the American Speaking Telephone Company, the Gold and Stock Telegraph Company and the Harmonic Telegraph Company against the American Bell Telephone Company, for violation of the agreement of Nov. 10, 1879. The complainants assert that under this agreement the American Bell Telephone Company was to enter into no more contracts with telephone exchanges and was to pay the Western Union Telegraph Company a certain percentage of rental or royalties on the patent then owned by the Western Union as soon as the use of the telephone reached a certain point. They claim that this point has been reached, and ask an accounting of all the property of the Bell Telephone Company, and an injunction restraining that company from further violation of the contract.

—— THERE appears to be a most prejudical feeling of jealousy—not commendable rivalry between some of the electric companies. Recent exaggerated and persistent attacks on the arc lights would seem to be inspired by something more than an excessive desire to protect the public from harm. Some papers have even gone so far as to attribute this animus to a leading electrician, and the entire anti-electric campaign to sordid motives. Electricians should know that such attacks must injure the interests of electricity in general. The public require to be familiarized with electricity, to regard it, as it truly is, as a great element of usefulness, and not as a mysterious death-dealing agency. "It's a vile bird that soils its own nest." Harmony and energetic action is what is required, not only in the interests of the public, but in those of electricians themselves.

THE ELECTRICIAN.

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TO OUR PATRONS.

AT the close of another year and another volume, we desire to announce to our many readers and advertisers that the generous and hearty support we have received from them, and for which we are very grateful, has prompted us to make arrangements for the future conduct of this paper, that will greatly enhance its value and usefulness.

The new volume will appear under the more comprehensive title of THE ELECTRICIAN AND ELECTRICAL ENGINEER, it will be published by the ELECTRICAL PUBLISHING CO., and, as our friends will be pleased to hear, Mr. Frank L. Pope will hereafter be its editorial manager. The paper will be greatly improved, and will be as heretofore, absolutely independent and impartial on every subject. It is intended to make this journal more particularly the exponent of electrical science in this country, but at the same time it will give to foreign matters within its field the space and attention which their importance to American readers may entitle them to occupy.

Mr. Pope will bring to the editorial chair of this journal rare literary skill as well as ripe experience as an electrical engineer, and he occupies a high place in the ranks of that large and growing class, whose wants this paper will be especially intended to supply. Mr. Pope's experience as a writer for encyclopædias and other scientific publications, as editor of a telegraphic journal for many years, and as author of one of the best hand-books of telegraphy in the language, ensures the possession of the literary faculty in a high degree, while his services in the management of telegraphic enterprises at home, and in the Russian-American overland telegraphic expedition abroad, as well as the numerous electrical inventions he has made, show him to be equally familiar with the practical and technical details of his profession.

Starting in life as a telegraph operator, Mr. Pope was one of the first in this country to adopt and put in practice the results of scientific investigation, and he has since steadily maintained his place in the front rank of American electrical engineers and writers on electricity as applied to the useful arts.

We congratulate our readers on the many advantages which they will reap from Mr. Pope's connection with this paper. Address all communications to THE ELECTRICAL PUBLISHING CO., 115 Nassau Street, New York.

1883.

AS the flight of time reveals the future, it also affords a wider retrospect of the ever growing past. The harvest of scientific research and skilled industry has added much to the sum of human knowledge, and increased the blessings of life. More than ever has electricity become a necessity in what is essential, and a luxury among comforts.

While the records of the past year have not been graced by any wonderful achievements in electrical science, there have been numerous contributions to its advancement, resulting from the diligent efforts of numberless workers as yet unknown to fame.

The fertility of resource of the American mind is shown by the number of patents issued upon electrical subjects. The patents show constructive rather than creative skill, and if the record lacks those brilliant flashes of inventive genius, comparable to those which produced the telephone, yet there must be a modicum of good amid the rubbish of scores of useless patents, and the final result of such a great amount of honest application must prove beneficial. Who can state the measure of prosperity due to the liberal policy of our patent laws in fostering useful inventions; and some of our States have experienced the result of wise corporation laws, framed to encourage upon an equitable basis, the union of invention with capital.

Although a review of the electrical progress of the year is indeed a summary of the record of current events published in our columns, yet this affords an occasion to consider some of the salient features of the year's work.

On account of its novelty, the enthusiasm for its future, and the promises of success, electric lighting has claimed the greatest attention during the year, although the actual financial investments are less than those of the other commercial uses of electricity.

In all new enterprises, the prescient faith of the vigorous worker is an element necessary to success, but that phase of electro-mania, which seeks something for nothing, is pernicious to every interest involved.

The prosperity of electric illumination cannot rest upon a firm basis until divested of much of its speculative character. In the May issue, we showed that the capitalization of the 92 electric light companies in the State of New York, amounted to $122,445,000; and if the three or four leading companies are omitted, it is doubtful if these companies possess one million of dollars worth of actual property. In England, the business of electric lighting has been far more seriously embarrassed, by the extent to which speculation has usurped the field which would have yielded rich returns to legitimate business transactions.

If Adam Smith were in the flesh, rest assured that he would classify "promoters of undertakings" among the non-producers.

Those not conversant with the details have little conception of the amount of toil required to bring the electric light to a commercial basis. Assistants had to be educated and artisans trained for this work; the market must be developed to furnish suitable supplies; and even it was necessary to invent and build steam engines to obtain desired results, and at this day, an American engine (Armington & Sims) is running the modern dynamos in the House of Parliament.

The question of engines for dynamos was considered of such importance, that much of our space has been devoted to an able series of articles on the subject.

The various schools of applied science are doing all that a technical school can do to furnish trained assistants in electrical science.

As an example of fine artisanship, we consider that the modern incandescent lamp is almost without parallel in the application of skilled handiwork to an article of manufacture. Consider the requirements, fashioning the material into a carbon filament, whose cross-section is certainly less than one five-thousandth of a square inch, yet the electrical resistance of each one must conform to a fixed standard, and be uniform throughout its length. The carbon must endure sudden extremes of temperature, and last for months while as hot as fused platinum; the vacuum must be the best attainable, the glass work comely, and above all, the whole furnished for the price of a very ordinary oil lamp.

Such success represents an unknown quantity of failures, and one wonders; could we draw aside the proper curtain, would not we see an incident similar to that of the valet of Beau Brummell, descending the stairs with a bunch of rumpled cravats, "these be our failures, sir!"

Among the textile mills, electricity has proven to be an ideal illuminant wherever the quality of the production made outside of the limits of daylight depends upon thorough illumination, exact discernment of colors, and the best physical condition of employés attainable by a pure atmosphere. But the small profits accruing from a large production of goods, has rendered the capital engaged in this business unusually timid, and exceeding conservative as to new expenditures, while sundry whispered expectations of new inventions of wondrous efficiency have tended to restrain purchasers.

No interest has so much at stake in the successful abolition of ærial wires as the electrical corporations, but no method of arranging subterranean arc light, telegraph or telephone wires has yet proven successful to the conditions that exist in New York.

Legislative stupidity has found frequent vent in enactments prohibiting ærial wires. Since it is an axiom of law that every wrong has a remedy, let these legal powers who put ærial wires under the ban, also show how to put them under the surface of the earth.

From time to time, we have given information respecting the efforts made in this direction, but the whole result is fairly stated in the last report of the directors of the American Bell Telephone Company.

"In the work of putting wires underground the progress has not been as satisfactory as could have been wished. Underground cables have been laid in iron pipes in Boston in two directions from the main office—one line being 1,200 feet, and the other 1,485 feet in length. Conversation is successful within short limits over these lines, but where they are used in connection with long lines—for instance those reaching to the suburbs—the voice becomes indistinct. Unless this difficulty can be removed, the connection with points outside of Boston would be almost if not quite useless to those whose wires were underground."

While great improvements have been made in electric lighting apparatus during the past year, no generically new line of development appears to have been taken up. Dynamo machines have been made more efficient and simplified in construction, arc lamps have been made more steady and reliable in operation, incandescent lamps have been improved in efficiency and durability, and many accessory devices have been developed and perfected which, in the aggregate, have largely increased the commercial availability of both systems of lighting.

Thus far, the effect of electric lighting upon the gas interests, has been of a beneficial nature. The fear of a competitor has encouraged the gas companies to adopt more modern processes, while the example of the thorough illumination in public places by electricity, has accustomed persons to greater artificial light, and increased the total consumption of gas about twenty per cent.

Experience has shown that the dividing line between electricity and gas is as strongly marked, as that between gas and kerosene oil.

As a result of strict attention to the continuous insulation of the apparatus, the electric light companies have not been compromised in matters of originating fires, during the past year, and the underwriters now consider a well arranged electric lighting plant as safe as any method of artificial illumination. It must not be forgotten that electricity, in common with all forms of energy, is dangerous in the measure that it escapes control.

Notwithstanding the large amount of threatened litigation on the subject, only two cases of especial importance have reached a decision during the year.

One decision set aside the Gramme patent, and was based mainly upon the principle that the expiration of a foreign patent terminates the United States patent for the same invention.

The other decision was to the suit of the American Bell Telephone Company against the Dolbear static telephone, and resulted in decreeing the injunction.

Should the Supreme Court upon hearing the appeal, decide that, in order to preserve the rights of Prof. Bell under the law, his invention covers all possible methods of electrical transmission of articulate speech, then his patent will be the broadest ever known, and embody the nearest approach which can be suggested to patenting a principle.

The Bell company is at present master of the situation, and the use of all improvements in telephony must be through this company. There are now 294,943 telephones leased in the United States, and the growing use of telephones will force the company to avail itself of every invention capable of improving the service in economy of time or material.

The telegraph is the factor which preserves the equilibrium of the commercial world; it traces the history of current events; and fixing prices by its record of supply and demand, performs service in nearly every transaction; and its absolute paralysis for a few hours would engender feelings of uncertainty and distrust, causing financial panic. For the extent of some of its operations, listen to the logic of figures taken from the report for 1883 of the President of the Western Union Telegraph Company:

Miles of poles and cables, 144,294; miles of wire, 432,726; offices, 12,917; messages, 41,181,177; receipts, $19,454,902.98; expenses $11,794,553.40; profits, $7,660,349.58. Large as this amount may be, it is estimated that the Western Union represents only three-eighths of the telegraph in the country, the remainder being principally the wires in the service of railways.

There are now seven Atlantic cables in working order, and the average profit is said to be seven and one-half per cent., so there is reasonable ground for assuming that the two new cables will prove satisfactory to the projectors.

The strike of the operators in July inflicted serious losses on both sides. Never was such an intelligent body of persons engaged in a strike, but the general public seemed to have little sympathy with any measures which interfered with the transmission of messages, and the strikers won a defeat. All strikes are to be deplored, and the question of the equitable compensation for labor of the various degrees of skill is a problem of civilization, which is more serious than that of slavery, in the measure that free labor is more valuable than slave labor.

The well-known physiological effects of electricity have given rise to many attempts for its general adoption, particularly for derangements of the nervous system; but its use is almost solely confined to the service of certain specialist physicians who are not professionally recognized by the medical fraternity. In the department of surgery, however, electricity has proved to be of great value.

We have had occasion to refer in terms of commendation to Leiter, of Vienna, Dr. Thomas Oliver, of Newcastle, England, and Dr. Roswell Park, of Chicago, for their services in using the incandescent lamps, in combination with specula, to illumine the interior of the body, and intelligently make diagnoses, which were formerly based upon mere conjecture.

Electricity has been used as a means of cauterizing; and of late, exquisites, dissatisfied with the growth furnished by nature, have availed themselves of electricity as a depilatory by cauterizing the follicles at the roots of the hair desired to be removed permanently.

Last year Prof. A. Graham Bell added to his fame by giving to the world a description of the beautiful adaptation of Prof. Hughes' invention of the induction balance used for the detection of masses of metal in the human body.

This apparatus was evolved from the imperfect device used to seek for the bullet in the body of the late President Garfield.

The science of electricity is becoming the handmaid of other sciences in matters requiring precise operation and accurate record; even the United States Fish Commission use the electric light in their investigations of the fish along our sea coast.

The improvements in the management of the light, have enabled photographers using the electric light to obtain the finest artistic effects. In the matter of electric watchmen's clocks, used by all large establishments, this country is certainly ahead of our transatlantic neighbors, where we believe the primitive methods of the pin clock are still in vogue, with all the possibilities of erroneous record, and sophistication by the unfaithful.

In the terminal railway stations, the signals for starting trains are given by an automatic signal apparatus, which is adjustable not only for a regular time-table six days in the week, but remembers the seventh according to the special schedule in use on Sunday, and also notifies gatemen to be at their posts, and passengers to leave the waiting rooms in due time for the departing trains. The telegraph and the automatic signals are essential to the safe operation of railroads.

In the matter of electric railways, operation has thus far been limited to experimental work in this country; but there are several electric railroads under construction, and the results of their operation will be recorded in due time.

Electro-motors have been thus far a matter of hopes and promises; there has been no electro-motor made which will automatically regulate itself to uniform velocity with variable mechanical resistance, and slight differences in current.

It is not unreasonable to demand of an electro-motor the same precision of operation which is required of a steam engine or water wheel. It is impossible to relate in the compass of a single article, the numerous uses to which electricity has been originally put during the last year, and in many an obscure device undoubtedly lies the germ of inventions which will prove a necessity to mankind, and we trust all useful inventions will bring adequate reward to their originators.

The literature of the heavy currents used in electric lighting, and all that pertains to the subject, scarcely made a beginning until the present year. Many of those, whose professional duties lay urgent claim for their services have imparted of the wealth of their experience.

Among the numerous contributions to the literature of electricity it cannot be considered an invidious distinction to refer to the Cantor lectures, delivered before the Society of Arts, by Prof. Sylvanus P. Thompson; and the lectures on electro-motors and their government, by Prof. Ayrton and Mr. Perry, as examples of clear statements of the present state of the art of using electric currents on a large scale. In the matter of electric literature, we are largely the debtor of our foreign friends.

Unfortunately, the contributions of such men as Prof. Henry Morton, or the inventors of the four great systems which are justly named after Brush, Weston, Edison and Thomson, are limited to a hasty interview, or a lecture which is general in its nature. It is to be hoped for the sake of the advancement of electrical science, that these gentlemen will give to the world. the results of their experience. Each of them in his own way has attained to eminent success, and there is naturally a disposition to learn of the processes in the advancement of their work.

On the other hand, when examining many of the superficial productions, teeming with lax statements, illogical in method, and too often lacking in good faith, one thinks of the mentor of years gone by, and longs for one hour of Michael Faraday.

The Vienna electrical exhibition introduced many tasteful matters of improvement, but it seems to lack the importance of the electrical exhibition previously held at Paris.

Careful preparations are in progress for the electrical exhibition, to be held under the auspices of the Franklin Institute, at Philadelphia, in next September. We commend it to our foreign friends as well as to our home readers, and trust that the exhibition will receive the co-operation of all interested in electricity.

About forty years ago, one of the principal examiners in the United States patent office, came to the mature decision that the work of the patent department must soon come to an end, because the inventive power of the human mind had reached its limit, and that there would be no further demand for new inventions. So, like a prudent man, he resigned, and engaged in portrait painting, which promised to be a good business to the end of time while vanity and funds kept company with humanity.

The marvelous growth of the American patent system is not merely the result of wise legislation, but an indication of a national trait which is doubtless the evolution of the economies rendered necessary by the privations of the early settlers of our country. Our patent system has outgrown the scheme of a generation ago, and the inventive interests require modifications which would reduce the amount of litigation necessary to enforce the title to disputed inventions. Although the time has passed when a judge on the bench could be deceived by an inverted planing machine, as was the case in one of the Woodworth suits, yet it seems proper to assume that many questions of fact could be more feasibly established before a tribunal, consisting of persons familiar with the class of invention in dispute, than before judges learned in the law, but whose education in mechanics is too often carried on in the court room.

The opportunity for new inventions extends as the demand for greater consumption grows. The development of one invention gives rise to a demand for others. We have already referred to the needs of methods of governing electro-motors, and to the desirability of some arrangement of protecting underground electric conductors.

At a recent meeting of the New England Cotton Manufacturer's Association in Boston, the burden of the session was not devoted to questions of mechanics or mill-engineering, neither did the financial problems of cotton manufacture receive attention, but the published reports show that the most serious consideration was given to the difficuties which beset cotton spinning during dog days. It is well known that this hindrance is caused by the accumulation of the static electricity generated in the action of the fibres on each other, and by the belts; and is not confined to cotton mills, but is shared to a greater or less extent by all textile mills. During these peculiar atmospheric conditions, the quality of the work is lowered, and the quantity of production reduced from six to eight per cent.

This meeting was attended by representative men in every branch of the cotton manufacture, and with their experience—upon a problem so serious, that one member made the statement that its solution would be worth millions to American mills—there was no method shown by which these difficulties could be overcome. The use of atomizers or vapor to control the humidity of the atmosphere, or the use of electrical conductors at belts, give only partial results. We referred to the matter at some length several months ago, and commend it as a subject which has received but little attention from skilled electricians, and is full of promise to the one who masters the subject and devises the means of preserving those atmospheric and electrical conditions most favorable to textile manufactures.

The necrology of the year shows that death has been busy, and that some of the leaders in electrical science have been called to their final rest.

This article does not afford an opportunity to give a fitting reference to Sir Karl Wilhelm Siemens, perhaps better known by its anglicised form, Charles William, eminent as a scientist, civil engineer and electrician, and like Michael Angelo, successful in the many enterprises and lines of study to which he devoted himself. Coming from Germany to London, at the age of forty years, his wonderful attainments placed him *primus inter pares*. He was recently invested with Knighthood by Queen Victoria, being one of the few persons foreign to British dominions, who have been thus honored.

Of the other more prominent electricians who have passed away, one of the oldest was William Martin, of Boston, who was an associate of Prof. Morse in constructing the first galvanic telegraph, and retained his connection with the Western Union in a position of responsibility to the last.

W. E. Sawyer, one of the earlier lights in electrical science, closed his life in a shadow of marked contrast with the earlier promise, justified by his brilliant scientific genius.

The death of Mr. Cromwell F. Varley, in England, was flashed through the submarine cables whose practical and commercial operations were more due to his electrical skill, than to any other single person. Richard S. K. Werdermann devoted himself to electrical science in such an unselfish manner that he did not provide a suitable competency for those dependent upon him.

M. Alfred Niaudet, a prolific writer, manager of the Societe Générale des Téléphone, and chairman of the Compagnie Internationale des Téléphones, of whom our excellent contemporary, *Révue Industrielle*, says:—"He was one of the first to foresee the part that would be played by machines in the production of electricity."

M. Brequet, a prominent electrician, member of the French Institute and of the Bureau of Longitudes, as also his nephew, M. Niaudet Brequet, a well-known electrician.

We forbear to mention others of lesser fame, whose talents have doubtless found suitable enconiums, and whose virtues received recognition by those of their personal acquaintance.

The limits of this review have estopped suitable reference to many features of electrical progress which must be considered of minor importance

Electricity is full of promise to any who choose to enter the faithful consideration of its principles, in their relation to the wants of man; and our object will be to continue a record of electrical success for

1884.

NOTICE.

IN our November issue we published a communication regarding the late K. S. R. Werdermann, of London, pointing out that he had left a helpless family unprovided for. Any who wish to contribute to a fund for their present relief may send checks to Clarence A. Seward, 143 Fifth Avenue, Henry Morton, Stevens Institute, Hoboken, N. J., Rowland R. Hazard, 173 Fifth Avenue, N. Y., Thomas E. Gatehouse, 22 Paternoster Row, E. C., London, England.

— AT THE PRESENT TIME, electric conductors are continuous half way round the world, and whenever a message is sent from England to Australia, direct energy is transmitted 10,000 miles, but in what quantity? The energy of the current, according to Professor Osborne Reynolds, as it arrives, is not much more than sufficient to keep a watch going, at any rate not more than 1-1000 millionths of horse-power. The value of such energy, estimated at £17 per minute, would be equivalent to a billion pounds per horse-power per hour, whereas the highest price paid for animal labor in Australia or England is not more than 6d. per horse-power per hour. This shows the difference between the transmission of electricity for telegraphic purposes and its transmission for mechanical purposes. Energy differs in value greatly, but for operations that can be performed by men or horses, the price of energy must be regulated by the highest price of corn.—*Engineer.*

— M. SAUER has constructed a battery that acts only in sunlight. The battery, as described in the *Electrotechnische Zeitschrift*, consists of a glass vessel containing a solution of 15 parts of table salt and 7 parts of sulphate of copper in 106 parts of water. Within is a porous cell containing mercury. One electrode is made of platinum, and is put in the mercury; the other is of sulphide of silver, and is placed in the salt solution. Both are connected with a galvanometer, and the whole is inclosed in a box when not in use. When the battery is placed in the sunlight, the galvanometer needle is deflected to a certain point, and the sulphide of silver is found to be the negative pole. Any change in the intensity of the light—such as a cloud over the sun—is indicated by the needle. The action of the battery depends on the effect of the chloride of copper upon the mercury. Sub-chloride is formed, and reduces the sulphide of silver; but this can only take place with the aid of sunlight. Hitherto the only manner in which light seemed to affect electrical action was by increasing the resistance of a selenium cell, and all photo-electrical experiments were based on this phenomenon.

THE ALLEGED DANGERS OF ELECTRIC ARC LIGHTING.

"There is but one Edison and Johnson is his prophet."
[Extract from *Edison Bulletin.*]

A GENTLEMAN of Philadelphia, well-known in electric circles, has occupied himself for many years in making a collection of *bric-a-brac* mainly relating to electricity and its practical applications. Not the least curious and suggestive of these objects is a cutting from a Philadelphia newspaper of some fifty years ago, containing a most emphatic and earnest protest against the proposed establishment of a system of gas lighting in that city. A terrifying catalogue is given of the direful consequences which must inevitably result from the general introduction of the new mode of illumination. The waste products from the works would kill the fishes and annihilate the fisheries upon the Delaware and Schuylkill rivers; the gas would take fire within the pipes, heat them to incandescence, and thus produce a general conflagration; the pipes would continually be broken or become leaky, and the escaping gas collecting and taking fire, would give rise to the most frightful explosions, tearing up the streets, shattering buildings into fragments like gunpowder, and scattering death and destruction far and wide. If it did not take fire, it would suffocate people in the streets and in their homes, it would kill the shade trees in the streets and parks, and destroy birds and animals, and so on at great length. To this manifesto is appended the signatures of a vast majority of the leading citizens of Philadelphia of that date.

It must be admitted that these predictions have been found by experience to be justified by the results. Frightful explosions have been produced, buildings have been blown to atoms and set on fire, men, women, and children, to say nothing of beasts, birds and fishes, have been blown up, poisoned, or suffocated in great numbers, and vast numbers of shade trees have been killed; nevertheless it does not appear that there is any general disposition on the part of the public to abandon this death-dealing illuminating agent and return to the comparatively harmless whale oil lamps and tallow candles of the ancient Philadelphians.

The same class of alarmists have now selected the electric arc lighting system as an object of attack upon substantially similar grounds. During the past few weeks the public has been regaled with a series of highly sensational essays under such captions as the following: "Sudden Death in the Air," "Wires that Burn and Kill," "There is Death in the Box," etc. The writer of these articles commences by solemnly assuring the public that "conflagration and death are threatened by every inch of the big arc light wires, of which hundreds of thousands of feet are strung up all over the city. They are a constant menace to the lives of those who walk beneath them, and to the permanence of the stately buildings whose architectural beauties they veil and mar." It would occupy too much space to repeat in detail all the preposterous falsehoods and misstatements with which these articles abound, and which purport to be given on the authority of an anonymous "expert of world-wide reputation." It is perhaps fortunate for that gentleman that the writer does not state in what the expert's reputation consists, inasmuch as there are persons who might regard the President of the celebrated Sazerac Lying Club as "an expert of world-wide reputation." We have only room for a few choice extracts: "The wires are liable to kill, with lightning's suddenness and celerity, the fireman who directs a stream of water across them." The force of the arc lighting current is "sufficient to pierce a plate of glass half an inch thick." "The slightest touch of the finger of a child or servant or ignorant person upon a storage battery is punished by instant and certain death." "The storage battery is more hazardous than powder or dynamite magazines, so far as human life is concerned." These quotations might be multiplied, but the above are sufficient to show the character of the attack.

It is quite apparent to any one familiar with electrical science, that these articles are not written in the interest of the public by some well-meaning person who has been led into error by misinformation and lack of familiarity with the subject, but, on the contrary, they are inspired by some thoroughly well informed electrician with the deliberate design of misleading and alarming the public by a skilful admixture of statements more or less true, with deductions wholly unwarrantable and mischievous. Bearing in mind the fact that there are practically three systems only of electric lighting from a central station now in use, namely, the arc lamp, the incandescent lamp supplied by storage, and the incandescent lamp supplied by direct currents, and that in these articles the most virulent denunciations of the first-two systems are coupled with a skilfully worded advertisement of the last, and the further well-known fact that the latter has wholly failed to achieve the commercial success which has attended the introduction of the former, the animus of the articles become apparent.

The truth is, as all unprejudiced electricians will admit, that arc lighting systems, like steam boilers, railways, gas-pipes, and hundreds of other necessities of modern civilization, may become exceedingly dangerous, when not properly supervised and controlled, but with the exercise of proper and reasonable care, the danger to firemen and the public generally, as well as to buildings and other structures from arc light wires, is practically inappreciable. The statement that persons may be killed, or even injured by electrified streams of water, and by electric currents transmitted through a wooden axe-handle, or through glass half an inch thick, are, of course, unqualified falsehoods which should never have been permitted to be published as facts in the columns of a reputable journal. The catalogue of persons killed and injured, is a short one, and consists, for the most part, of employes of the lighting companies, who are necessarily obliged to handle the apparatus and wires almost constantly, and who have suffered from the results of their own or their fellow employes' carelessness. No instance has ever been reported in which any person within a building, or the building itself has been injured by reason of arc light wires passing in front of it. No loss has ever been paid by the insurance underwriters, nor has any claim ever been made for damages resulting from arc lighting wires. Such attempts to injure the business of competitors by exciting unfounded alarm and prejudice in the minds of the public, cannot but ultimately recoil upon the particular interests they are intended to serve, with far greater severity than upon anyone else.

—— SEVERAL MONTHS AGO, we gave publicity to the method by which one could obtain correct time from the astronomical observatory at Harvard University, Cambridge, at the price of a ten-word despatch at any Western Union telegraph office. At the present time telephone subscribers in Boston can obtain the standard time, as given by a circuit closer. The time is sounded in clicks, like the blows of a fire alarm. Thus, if four clicks were heard, and then six, the time would be six minutes past four. The expense of the matter has been borne by the New England Telephone Company, and all their circuits will be equipped with the novel feature, for the use of their patrons without extra charge, as soon as the apparatus can be placed in position.

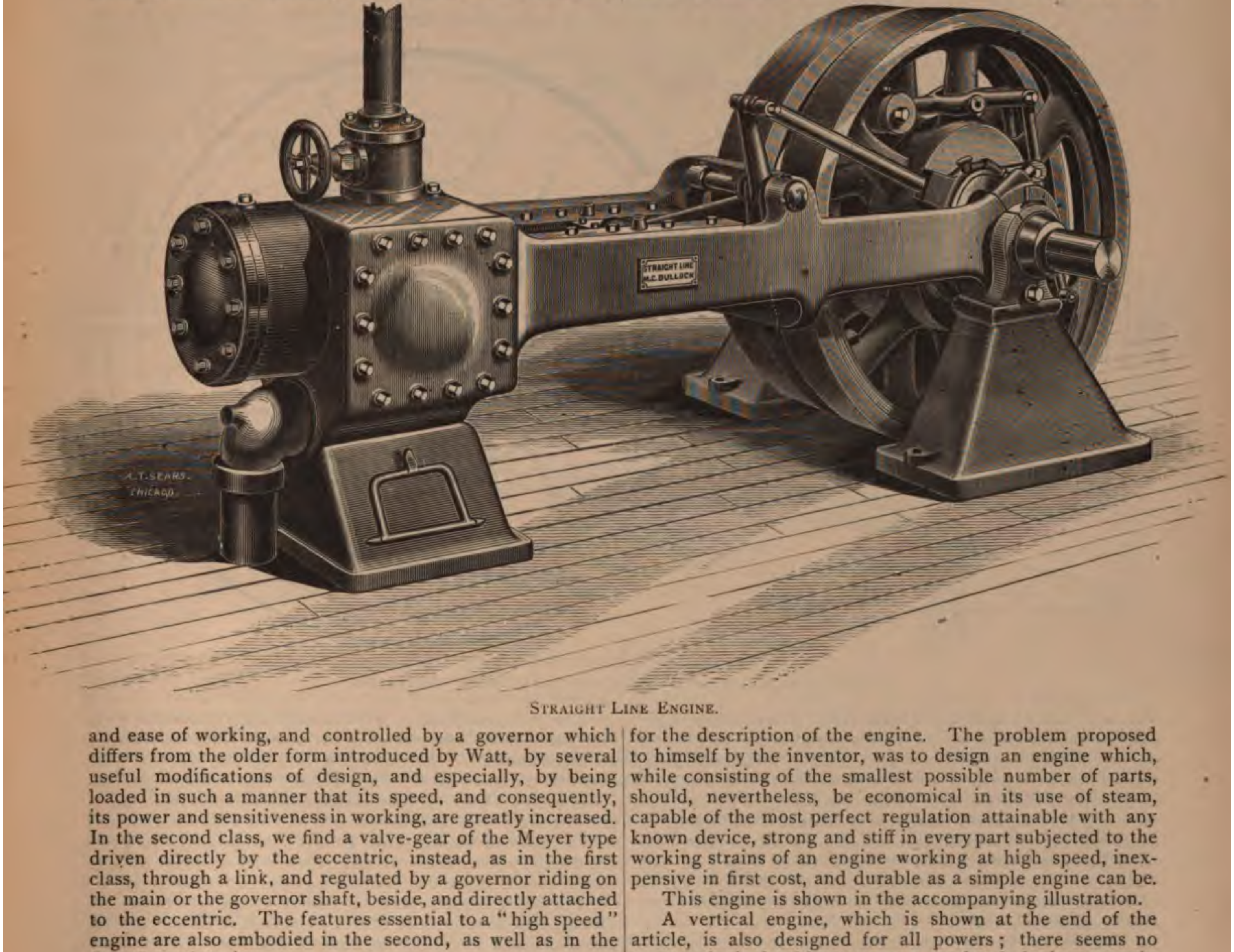
STEAM ENGINES FOR ELECTRIC LIGHTING PLANTS.

BY ROBERT H. THURSTON.

IV.—ENGINES CAPABLE OF DIRECT CONNECTION.

THE STRAIGHT LINE ENGINE.

REVIEWING what has been said in this section of engines capable of direct connection to the dynamo, it will be noted that the engines, which have now been described, have belonged to two classes, differing from each other in two very important respects. In the first, represented by the Porter-Allen engine, we find a form of engine especially, and very ingeniously, designed for high speed of rotation, fitted with four balanced valves, with the object of securing minimum "dead space," and maximum economy, and ease of working, and controlled by a governor which differs from the older form introduced by Watt, by several useful modifications of design, and especially, by being loaded in such a manner that its speed, and consequently, its power and sensitiveness in working, are greatly increased. In the second class, we find a valve-gear of the Meyer type driven directly by the eccentric, instead, as in the first class, through a link, and regulated by a governor riding on the main or the governor shaft, beside, and directly attached to the eccentric. The features essential to a "high speed" engine are also embodied in the second, as well as in the first class of engine.



STRAIGHT LINE ENGINE.

We now come to the examination of a third-class of high speed engine, which differs as radically from the two preceeding as they from each other. In this new form of engine we find but a single valve which does duty both as a distributing and as a cut-off valve. A form of engine belonging to this çlass, with which the writer happens to be familiar, is that known in the market as "The Straight Line Engine."

This engine, so far as it is novel, is the invention of, and also is designed by, Professor John E. Sweet, formerly the superintendent of the workshops in which instruction in machine work was given in the Department of Mechanical Engineering of Cornell University—a position in which he became widely known as one of the most skilful and ingenious mechanical engineers in the United States—and now President of the American Society of Mechanical Engineers. The first of these engines was built at Ithaca for experimental purposes, by students, under the instruction of the designer.

The Straight Line Engine has many interesting and novel points, which will bear much more extended study than they can be given in the small space which can here be allowed for the description of the engine. The problem proposed to himself by the inventor, was to design an engine which, while consisting of the smallest possible number of parts, should, nevertheless, be economical in its use of steam, capable of the most perfect regulation attainable with any known device, strong and stiff in every part subjected to the working strains of an engine working at high speed, inexpensive in first cost, and durable as a simple engine can be.

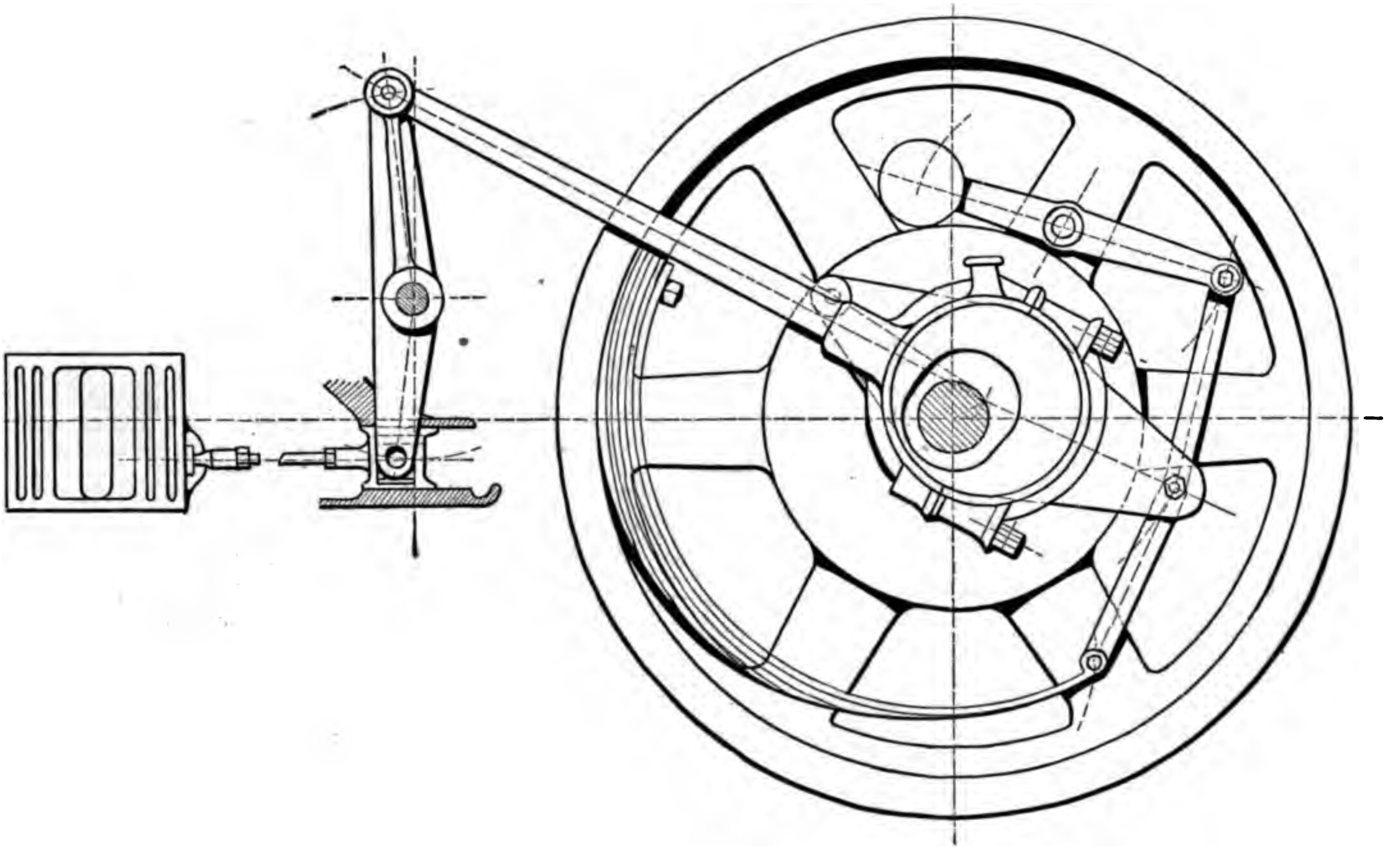
This engine is shown in the accompanying illustration.

A vertical engine, which is shown at the end of the article, is also designed for all powers; there seems no reason why it should not prove a good style for heavy work; better in some respects, in fact, than the horizontal engine

The engine takes its trade designation from its peculiar form of frame, which is seen to consist of two perfectly straight diverging struts extending from the end of the cylinder directly to the two main bearings, thus carrying the line of resistance to the pull and push of the connections exactly along its own central line. No possible arrangement could give greater stiffness with the same weight of material. The whole structure is carried upon three points of support, as is the practice with "surface plates," which must, if possible, have an absolutely definite and invariable system of suports, to avoid the slightest danger of "spring." These points are under the main bearings, and beneath the steam cylinder. The two journals receive equal loads; the crank-pin is not subject to the deflecting forces met with where a crank is overhung; danger of unequal wear of journals, and of springing the pin, is thus avoided very completely. The fly-wheel is placed in twin-form between the main bearings, and also serves as crank, thus making the best of cranks as well as balance wheel. This position of the balance wheel is one of peculiar advantage. By its action at this point, it intercepts heavy and objectionable stresses, which, in other engines, are transmitted to the main shaft; and the reciprocal action of counterweights and equilibrating parts is thus only felt within a mass of metal, which can resist them with perfect safety, and without their being felt in the more sensitive parts of the machine. This arrangement renders the main journal less subject to springing under the loads transmitted through it. To secure better distribution of wear, the crank shaft is allowed some end-play. This end-play, together with the carefully arranged system of lubrication, are the best possible insurance against excessive friction and wear.

The steam cylinder has the appearance of the cylinder familiar to every one, as seen on ordinary plain slide-valve engines. Its valve chest is placed at the end nearest the crank, and the ports and passages are carried as in those engines. The valve stems have no stuffing boxes, but pass into the chest through unusually long and carefully fitted holes in a hub, made about five one-thousandths of an inch larger than the rod inside the Babbitt metal bushing, for a length of six diameters or more. This hub is loose in the hole in the end of the valve chest, and packed at the ends by a washer fitted on a flat seat on the inside. The piston-rod is similarly fitted.

The crosshead is a very long casting which overruns the guide at each end at every stroke, and thus is rendered safe against wearing to a shoulder. A pin subject to reciprocating efforts in any part of an engine, whether it rotates, or carries a rotating or a vibrating piece, is apt, in time, to show wear on the two sides in line with the principal pull or thrust, and to lose its cylindrical form. In this engine, such wear is avoided at the crosshead pin, by cutting away the surfaces, which do little or no work, and thus securing overrunning surfaces, which are not subject to this distorted wear to so great an extent. Many other minor points invite attention, but they cannot be here considered.



Straight Line Engine.—Governor and Valve Gear. Elevation.

The principal feature of this design, in connection with that phase of its work which is of especial interest here, is its valve-motion. The valve is a rectangular block, sliding between the seat and a coverplate; is shown in the engraving. Ports are cut through the coverplate, through the valve, and through the seat into the steam and exhaust passages in the cylinder casting, in the proper positions. These ports are double at the ends of the valve, and a single port of ample area is made through the middle of the valve.

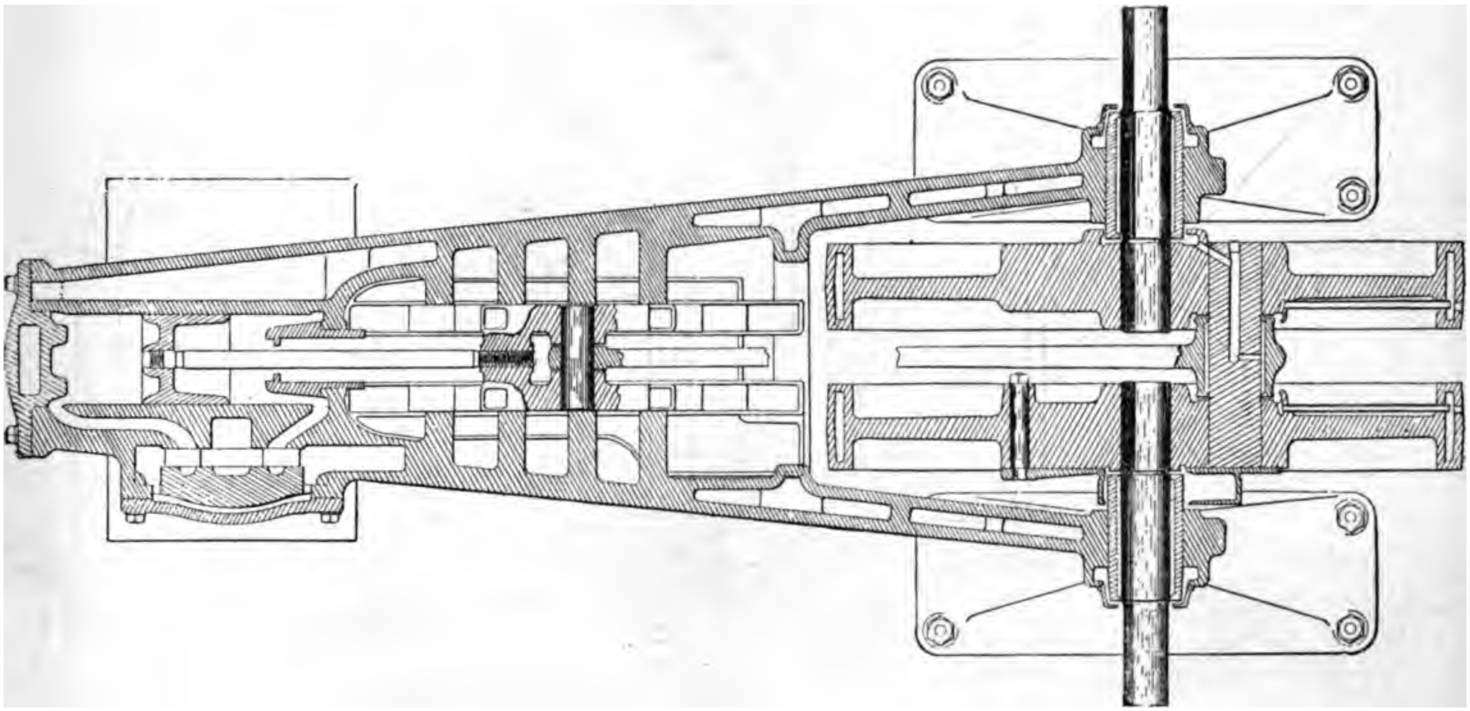
The valve is what may be called a "piston valve" of rectangular section, the space in which it slides having, therefore, also a rectangular section, and permitting the use of a detached coverplate, which, while sustaining the pressure of steam that would otherwise come upon the valve, and thus making it a balanced valve, nevertheless allows any unusual pressure, occurring when the piston comes back to the compression period of its cycle, to raise it, and thus to permit the water which may have caused the pressure to flow back, and thus relieve the cylinder, and obviate all danger of forcing out the heads. The principal feature of this device is not new; the writer handled such a balanced valve on marine engines, rated at above 5,000 horse-power, nearly twenty years ago, and found them, so far as his own experience went, perfectly satisfactory. This new application of the principle, however, embodies some new and interesting points. The valve cover is sustained on loose packing strips, which are free to close up upon the edges of the valve, and to take up wear as it occurs. The form of the plate, its domed top, is such as to give it great stiffness against the superincumbent pressure, and thus to prevent pressure on the valve itself in consequence of spring in the plate, and the ports are so placed as to prevent the cutting away of the faces and seats by the rushing currents of steam.

The valve and cylinder ports are not dressed out; the casting is made so accurately that these edges can be left as they come out of the sand without loss of efficiency in the working of the valve.

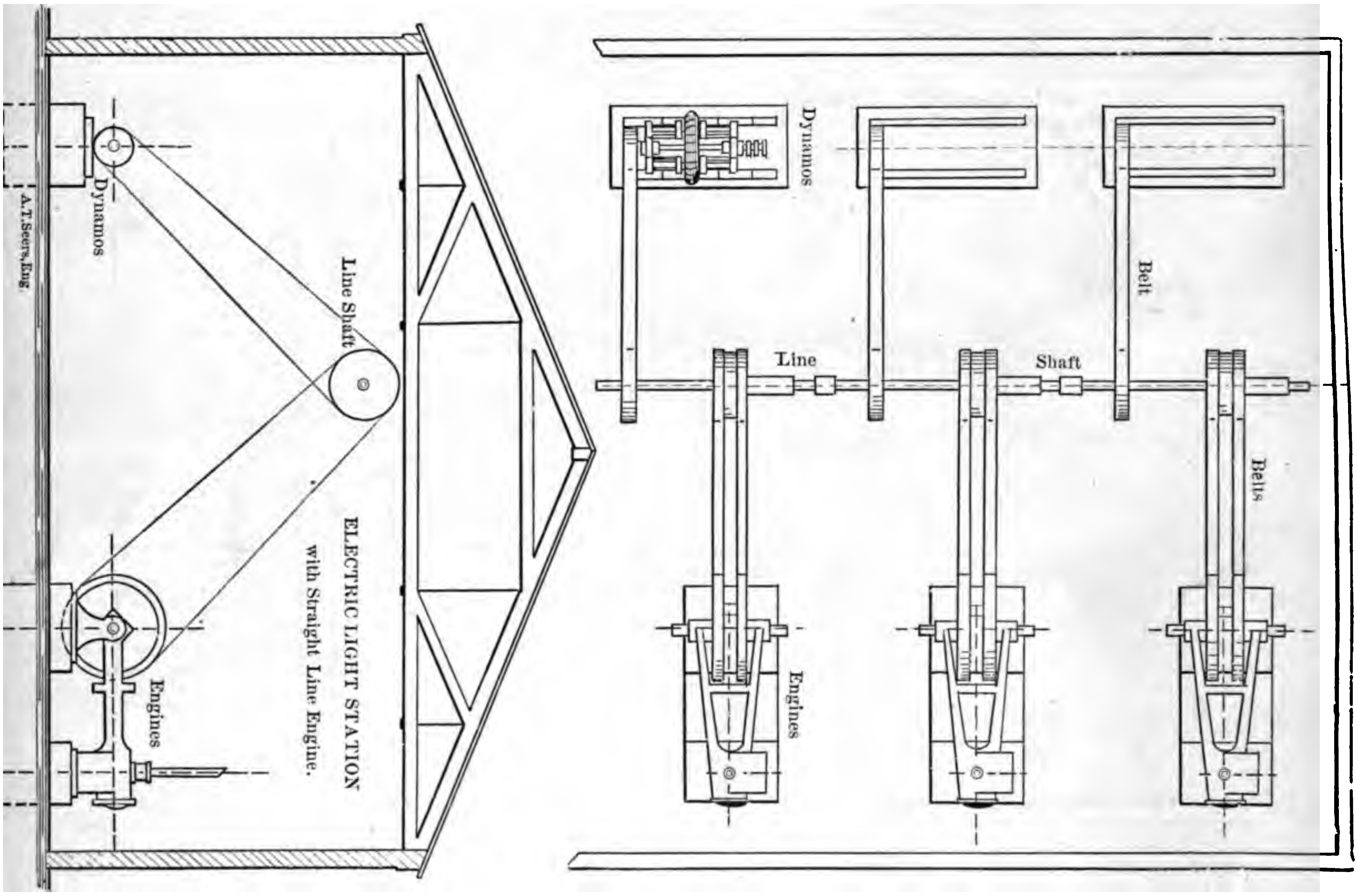
The valve is driven by an eccentric, the motion of which is controlled by the governor, and the connection of which with the valve is effected by the peculiar system of linking, seen in the preceding illustration. The eccentric is so suspended from the disc, to which it is attached, that it may be thrown across the shaft by the action of the governor, in such a manner as to give the effect of the once common and well known "Dodd motion." It is carried on a lever, which is pivoted at one side of the shaft, while the governor rod is attached at the opposite side. The singular positions of the eccentric rod and the rockshaft arm enable the alteration of the throw of the eccentric produced by the governor, to be effected without alteration of the lead of the valve, so that the steam may be admitted, at all times, at the same point in the revolution of the engine. This it does, since the line of the eccentric rod is, at the commencement of stroke, in line with the lever on which the eccentric is carried.

The governor is similar, in principle, to those which have been described as used on the last type of engine. It consists of a single weight, or ball, carried on the end of a lever which is pivoted, near its middle point, on one of the arms of the governor pulley, and connected to the spring, by which it is held under control, by a link extending across to the other side of the shaft to the end of the spring, which is there secured to the rim of the pulley. The action of the governor is substantially the same as that of those which have been already described. When the speed decreases, the tension of the spring, at the end of the weight lever, overcomes the centrifugal effort of the ball, and the latter is forced in toward the shaft, carrying with it the end of the eccentric lever, and thus giving the valve greater throw, and extending the period through which the steam follows the piston, producing more power and bringing the engine up to speed. The reverse change of speed of engine produces the opposite action of eccentric and of valve motion, and the cut-off is shortened, and the power of the engine is reduced to that needed to give the correct speed. As this governor may be made as nearly isochronal as may be desired, the approximation to correct speed may be made as close as is consistent with the sensitiveness considered permissible. The use of a single eccentric and of a single governor ball, and the general simplicity of this combination, are especially pleasing to the engineer. They, however, include the use of a single valve, and thus restrict the designer, somewhat, in his adjustment of the steam distribution, a restriction which the more complicated forms of valve-gear are constructed to avoid, as it is well understood that the economy of the machine, in its use of steam, is to a certain extent, dependent upon the method of distribution of the steam entering, and of the exhaust leaving the cylinder. The main objection is the fact, that the mean pressure of the steam entering the cylinder up to the point of cut-off is necessarily less with a single valve than with the gear introduced by Sickles and Corliss, and their successors, and which have been long standard, and which are admittedly superior in this respect. Whether the more costly, but more efficient gear shall be used, is to be determined partly by the cost of fuel, and must be settled by the judgment of an experienced engineer in each individual case.

The difference in this respect is not, however, as great as has been by some engineers supposed, and the economical value of heavy compression is now becoming so well


STRAIGHT LINE ENGINE.

understood, that the general impression in regard to this system of valve motion is becoming considerably and rapidly modified. What is lost by the drop of pressure between the boiler and the piston, is partly compensated by the variable and automatically adjusted compression obtained with this kind of motion, as is well illustrated in the action of the Stephenson link as used on the locomotive. With this arrangement, there is also some loss at the exhaust period, but not usually enough to be considered serious. As this particular engine is operated, this latter loss, and possibly, to a slight extent, the former, are somewhat reduced by setting the valve without lead, or even with "negative lead," *i. e.* so that the engine does not take steam until the crank has just passed the center, and the piston is starting on the forward stroke.

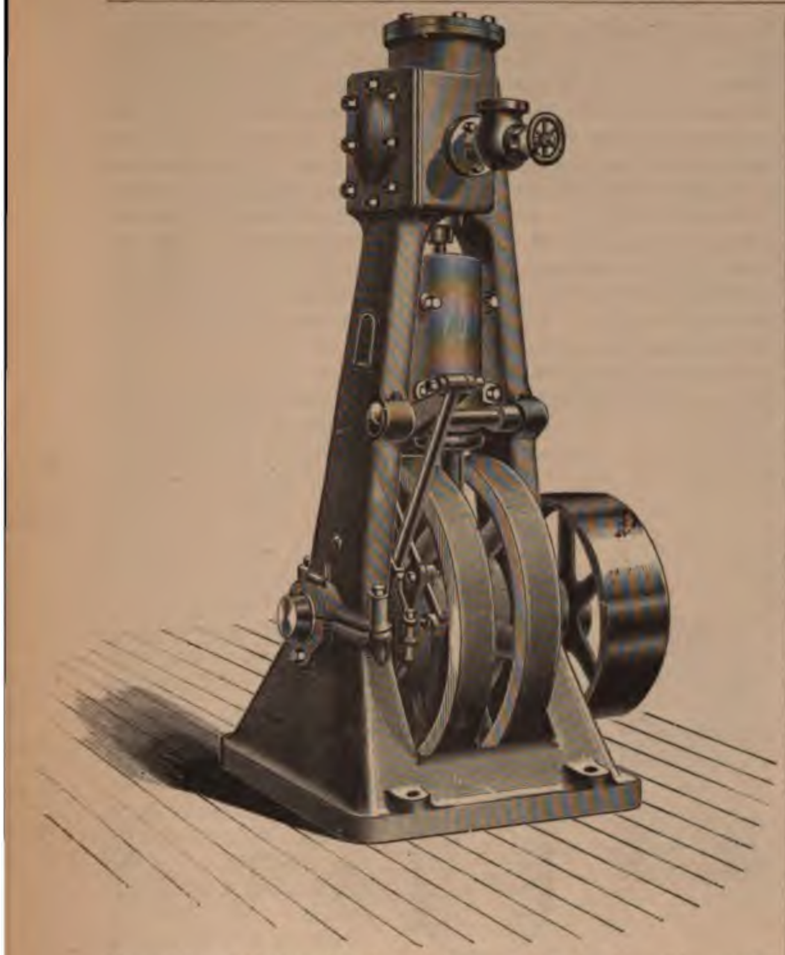


ELECTRIC LIGHT STATION with Straight Line Engine.

The engine, as a whole, with all its important parts in section, is shown in the above engraving. The unusual quantity of material as compared with earlier practice in older forms of engine, the excellent distribution of that material, the small number of parts, the heavy crosshead, the arrangement of fly wheels, and the form of valve are all plainly seen, as well as the general arrangement and system of connection. The rods and pins, and all running parts are made of steel; journals are ground to perfect form and polished, and the engine, when completed, is set up in the shop and carefully tried before sending it out, as is becoming the custom with good builders everywhere. The designer has made a special effort to reduce friction to a minimum, and has given the engine easy running piston and crosshead, perfectly formed journals, and a valve gear and governor, which are as nearly frictionless as those parts can well be made. The growth of the engine into its present shape, from the first crude sketches made in 1869, to the finihsed engine and completed type of to-day, and especially the gradual evolvment of the governor and valve gear from the older forms, would be an interesting subject of study, but cannot here be undertaken. The survival of the fittest, among these devices, has led to the production of the engine above described.

The Straight Line Engine has been frequently applied to the driving of electric lighting apparatus. In Penney's arrangement of a station of 120 lights, the connection of power to dynamo is effected through friction clutches, which may, at any instant, be thrown out or thrown in; any two of the engines have ample power to drive all three of the dynamos used, and a reserve is thus supplied to be used in case of the necessity of throwing off one engine for repairs. The current from any one generator is capable of being switched into any circuit, and all parts are accessible for examination and repair. A novel device is that of placing the driving pulleys, on the main line, on separate hollow shafts, independently supported, to prevent the springing of the line shaft by the pull of the main belts. The line shaft runs directly through the jack shaft, carrying the driving pulley on the line.

As this engine is adjusted, with large compression when at regular speed, doing the rated work, with negative lead on



the valve at that point, becoming positive lead at ¾ cut-off, it illustrates well the efficiency of the class. A 50 horse-power engine, driving a 40 light dynamo, according to the report of the manager at the station, ran at 219 revolutions, and at 220 when 27 lights were thrown off. The writer, testing one of these engines, using a Prony brake to take up the power, counted 233 revolutions, light, and 232, loaded with above 40 horse-power; with lower steam, the figures became 231 and 230. A well-balanced valve and a nearly frictionless governor are the elements giving success here. Every good engine, driving dynamos, is probably expected to rival this, doubtless, but, doubtless many do not. The single-valve engine can evidently, as is here seen, be made, by a skilful engineer, to do excellent work.

—— A NOVEL APPLICATION of the science of photography to the art of gunnery has been introduced at the royal gun factories in the Royal Arsenal, Woolwich, by Col. Eardley Maitland, royal artillery, and some very successful plates have been taken showing defects in the bores of guns sent back for examination after trials. The electric light, powerful lenses, and mirrors are employed for this purpose. Minute flaws in the metal undetected by the usual gutta-percha impressions have been rendered clear to the eye by these photographs, and they are likely to prove of essential service.

—— MR. KELLINGWORTH HEDGES recently read a paper before the British Association on "The Fire Risks of Electric Lighting," which concludes as follows:—When the work has been properly supervised, no trouble should be experienced, and the electric light may be said to be much safer than gas, as it is free from those accidents which are due to a servant's carelessness, or by leakage of the pipes. Whatever danger there is with electric lighting, is entirely localized to the generating station, where the dynamos and engines would be under constant supervision.

SKETCHES OF ELECTRICAL HISTORY.

BY WALLACE GOOLD LEVISON.

XII—ELECTRIC SPARK IGNITION.

PART III.—ELECTRICAL BLASTING.

ALTHOUGH so little difficulty was experienced in igniting vapors and gases by the electric spark, less volatile substances were at first only with great difficulty ignited. In one of his letters to the Royal Society, in 1747, William Watson says:[1] "I have made several attempts to light gunpowder, both cold and hot, but have not succeeded. That is because the powder gives off no inflammable vapor, and the same is the case with fulminating powder.[2] The electricity merely attracts and repels dry powder. But I have succeeded in igniting powder, and even *discharged a gun* by an electric spark, by mixing the powder with a little camphor or certain inflammable volatile oils." These experiments of Watson's initiated the modern art of electrical exploding.[3] It was soon found possible to ignite gunpowder directly by the spark; the essential condition of success in its ignition, and that of non-volatile substances generally appearing eventually to be the inclusion of a relatively poor conductor in the circuit. The advantage of introducing persons in the circuit in the firing of spirits, and the facility with which alcohol may be lighted by an icicle, being thus explained. "Conveyed by metallic conductors the spark passes in such cases with too great celerity to initiate the combustion.[4] Oblige the discharge to leap a *wide* air space; to traverse a long wet cord, or a foot or two of water in its circuit, and owing apparently to the retardation of its velocity, it will determine even a difficult ignition."[5]

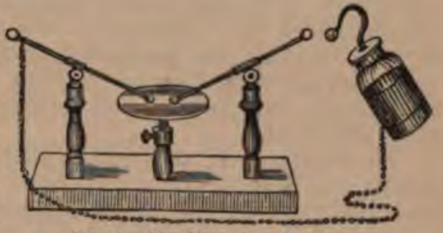


Fig 90.—The Universal Discharge.

In illustration, place some gunpowder between the poles of the apparatus, Fig. 90, called the universal discharger, and transmit through it the discharge of a Leyden jar. The powder will be scattered in all directions but not ignited. Next charge the small ivory mortar, Fig. 91, within which two conducting wires nearly meet, and including in the circuit 10 or 12 inches of water in a porcelain plate, repeat the discharge, when the powder will be exploded.[6] Placed, therefore in the open, wooden cup, devised by Sturgeon,[7] Fig. 92, gunpowder will always be ignited on receiving a spark from above, and so in any receptacle it will be usually fired by a spark from an icicle, because in the first case the wooden cup, and in the second the icicle, retards the discharge.[8]

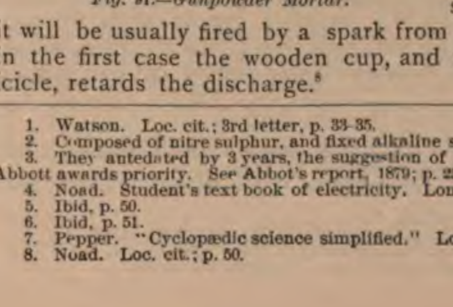


Fig. 91.—Gunpowder Mortar.

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[1] Watson. Loc. cit.; 3rd letter, p. 33-35.

[2] Composed of nitre sulphur, and fixed alkaline salt.

[3] They antedated by 3 years, the suggestion of Franklin, to which Gen. Abbott awards priority. See Abbot's report, 1879; p. 252.

[4] Noad. Student's text book of electricity. London, 1867; p. 50.

[5] Ibid, p. 50.

[6] Ibid, p. 51.

[7] Pepper. "Cyclopædic science simplified." London, 1869; p. 265.

[8] Noad. Loc. cit.; p. 50.

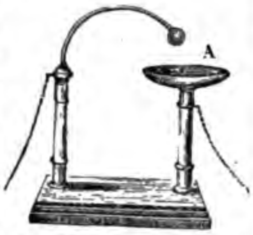

Fig. 92.—Gunpowder Cup,

The ignition, by the spark, of gunpowder enclosed in a cartridge was probably first accomplished by Benjamin Franklin in 1750;[9] but not practically employed until Mr. Moses Shaw, of New York, fired a blast in the year 1831,[10] nearly a century later. Since then electrical exploding has become a special and intricate art. It has been found not only a convenience in the conduct of ordinary blasting operations, especially when nitro-glycerine or similar detonating explosives are fired in damp situations, but by its adaptability to the simultaneous ignition of numerous separate fuzes, either distributed throughout one, or in separate mines, it has rendered possible both industrial and military engineering operations on a scale of extraordinary magnitude which its development alone rendered feasible. Of these the first noted example was the cutting through for railroad purposes of the South Down Cliff, 400 feet high and 300 feet long, near Dover, England, by Mr. Cubitt, in 1843, when 400,000 cubic yards of chalk were detached at once by the simultaneous explosion of three separate charges of 18,000 pounds of powder each.[11]

Since the removal of the wreck of the Royal George, by Sir Charles Pasley, in 1839,[12] the first noted instance of the use of electrical ignition in subaqueous blasting, and the partial removal of the obstructions at Hell Gate, in 1851, by Mr. B. Maillefert, the spark has almost entirely superseded the expensive so-called "electric fuze," which necessity had so wonderfully perfected. But in submarine, as in overground engineering operations, either civil or military, by its applicability to simultaneous ignitions it has permitted the achievement of most remarkable operations. Of these, the successful blast at Hallett's Point, near Hell Gate, by General Newton, in 1876, when 3,640 charges of powder were simultaneously ignited, is the most notable example.[13]

The literature of electrical exploding is somewhat restricted and difficult of access, since its development has been effected chiefly by secret experiments of leading governments; but it seems decided that the progress of the art has been wholly dependent upon: 1st, the insulation of the conducting wires; 2nd, the construction of the fuze; 3rd, its priming, and 4th, the quality of spark employed. The first submarine cable being of cotton covered, copper wire, varnished with asphaltum and beeswax, originated with Col. Colt earlier than 1842.

In 1848, Faraday first recommended gutta-percha as an effective insulating material,[14] and almost immediately, as a vulcanized preparation, it was applied by the Electric Telegraph Company, of London, to the covering of conducting wires, being found especially suitable;[15] and long, almost exclusively, used for subaqueous conductors, though cotton covered paraffined wires, resembling Colt's early cables, are now often used.

Mr. Statham, Manager of the Electric Telegraph Company, discovering that the coating of sulphide of copper which lines the tube, left upon drawing a copper wire out of its gutta-percha covering, is a retarding conductor to an electric discharge,[16] devised the first typical electric fuze, which is even now frequently used, being simply constructed as follows: From a wire *c*, Fig. 93,[17] covered with gutta-percha the covering is partly removed, and the wire is bent double and twisted together. It is then cut through or interrupted half way between *c* and *c*, opened and a piece of old gutta-percha covering slipped over one end. The two ends being then brought in a line, the piece of gutta-percha is slipped over both, and a V shaped piece cut out of it from *a* to *b*, care being taken to leave undisturbed the internal coating of sulphide of copper it contained, which is left to form what is technically called a bridge between the two ends of the wire. If an intensity discharge be now sent through the wire, it will leave it at one end and leap to the other, along the bridge of sulphide of copper, but in so doing, will encounter so much resistance as to ignite the sulphide. Mr. Statham found that gunpowder placed in the cavity *a*, *b*, would be invariably exploded by an electric discharge. When, however, a number of fuzes were to be ignited, either in circuit or in multiple arc, it was found necessary to substitute for gunpowder a more sensitive priming; and Col. Verdä, a Spanish engineer, by thus using fulminate of mercury, effected a simultaneous explosion of six mines in circuit, at a distance of 900 feet from the operator, by the spark from a small induction coil. But the tendency of fulminate of mercury to corrode the ends of the wire, and other objections, rendered a different or more sensitive substitute desirable. Mr. Abel, aware of the conditions required, devised a composition which has been phenomenally successful, and served as a type for numerous later competitors. Abel's composition contains:[18]

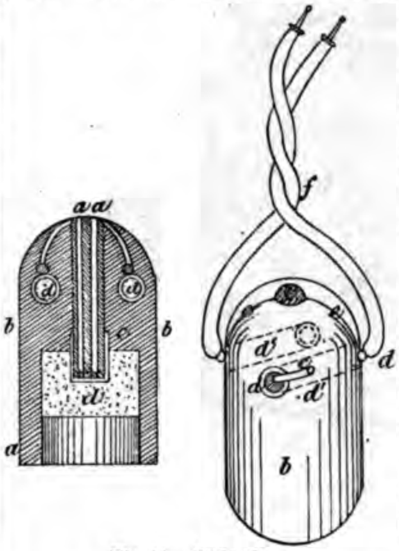

Fig. 94—Abel's Fuze.

Sub-phosphide of copper	10 parts.
Sub-sulphide "	45 "
Chlorate of potash	15 "

The materials are, separately, finely ground, moistened with alcohol, well mixed, and applied as a paste between the copper wires; or first dried and then applied. When this priming is used no other bridge is necessary, as the sulphide of copper it contains gives the requisite degree of conductivity. Abel, therefore, in 1858, made a fuze,[19] by simply fastening two copper wires on opposite sides of the little block of wood with their ends projecting, and filled the space between them with the prim-

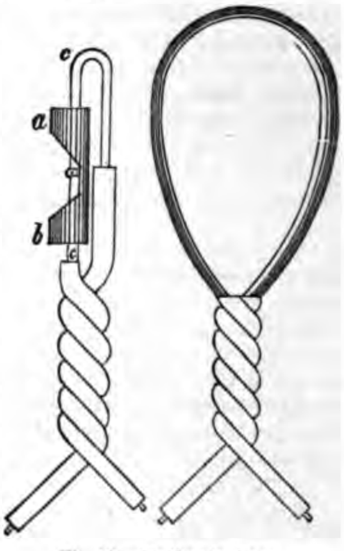

Fig. 13.—Statham's Fuze.

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[9] Franklin. Life by J. Sparks. Boston, 1856. Letter to Collinson, July 27, 1750; Vol. V., p. 223. Abbott. Loc. cit.; p. 252.

[10] Abbott. Ibid; p. 252.

[11] Encyc. Brit., vol. IV; p. 5. Abbott. Loc. cit. Also, Hutchinson, Lieut. R. E., Prof. papers, Royal Engineers, Vol., VI; p. 188.

[12] Barnes, J. S. Submarine warfare, N. Y., 1869; p. 161. Encyc., brit. Vol. IV; p. 757.

[13] Abbott. Loc. cit.: p. 244.

[14] Faraday. Phil., Mag, Mch., 1848; XXXII, p. 165. Also, ex. res.

[15] Faraday. Proc. Roy. Inst., January 20, 1854. Also, ex. res. p.

[16] Noad. Student's text book of elec. London, 1867; p. 313.

[17] From torpedoes and torpedo warfare. C. W. Sleeman, Portsmouth, 1880; p. 37.

[18] Noad. Loc. cit.; p. 314. And Abbott, loc. cit.

[19] Abbott. Loc. cit.; p. 200. Also, Sleeman, loc. cit.; p. 37.

ing composition. This is the typical form of most of the numerous spark fuzes now employed, and its latest construction is shown in Fig. 94, as a result of considerable study.

(*To be continued.*)

THE ACTION OF THE DYNAMO.

BY LIEUT. B. A. FISKE, U. S. N.

Author of "Theory and Practice, or the Elements of Electrical Engineering."

PART I.

IN order to get a clear idea of the principles upon which the action of dynamo machines depends, it is necessary to first get a clear idea of the meaning of the term "potential," as used in electrical science. Potential may be briefly defined as power to do work; electric potential being due to electric force, and magnetic potential being due to magnetic force. As the idea of potential thus involves the idea of work, potential can be, and is measured in the same terms as those in which work is measured; *i.e.*, in ergs. An erg, as we know, is the unit of work, and expresses the amount of work expended in overcoming unit force through unit distance, as for instance, in raising a weight of one dyne through a distance of one centimetre. When the weight has thus been raised by the expenditure of one erg of work, it may be said to have unit potential, because, if liberated, it will fall, and in falling, do one erg of work.

To obtain an expression for electric potential, the supposition is made that a plus unit charge of electricity is forcibly brought up *against* the repelling force of a fixed charge of the same name, in the same way that a weight is raised *against* the attracting force of the earth. At length (supposing the fixed charge to be great enough) the work done will be one erg; work being, as we know, the product of force by distance. When our unit charge has reached this point, it has the power, if liberated so as to be able to obey the repelling force, of doing the same amount of work as has been expended upon it; therefore it has a potential, or power to do work, of *one*. In order to start with a plus charge out of the influence of the fixed charge, the supposition is that it starts from an infinite distance.

By the same reasoning, an expression is obtained for unit magnetic potential; the supposition being made that we forcibly bring up a plus unit magnet pole from an infinite distance against the repelling force of a fixed plus magnet pole, until unit work has been done. The point then attained is said to have unit magnetic potential, because a unit magnet pole, if placed at that point, would be repelled to an infinite distance, and so perform a unit of work.

The significance of "electric potential" may not yet appear manifest; but when it is recollected that the efficiency of dynamo machines is measured by the ratio of the electrical energy produced, to the mechanical energy expended, its bearing begins to become apparent, because we see that it gives a way of measuring what the electrical energy is. We have seen that a unit of electricity in falling through a unit of potential does one erg of work. Therefore Q units of electricity in falling through E units of potential must do $Q\,E$ ergs of work.

As an electric current consists merely of units of current falling through units of potential, and as we have instruments for measuring the number of units passing per second (ammeters), and instruments for measuring the potential through which these fall in a given circuit (voltmetres), we have at once a way of getting the electrical work done in any circuit.

As we know, the unit of current (or electro-magnetic unit) is not that thus far considered; but as the unit of potential used with it is based upon the principle that a unit of current electricity in falling through it does one erg of work, the product $Q\,E$ still gives in ergs the work done. As in practice the unit of current is $\frac{1}{10}$ this electro-magnetic unit, and the unit of potential is 10^8 times this unit of potential, the product $Q^1\,E^1$, in which Q^1 and E^1 are both practical units, equals

$$Q \times E \times 10^{-1} \times 10^8 = Q\,E \times 10^7.$$

Now as a kilogrammetre $=$ 1000 x 100 x 981 ergs, we see that

$$\frac{Q^1\,E^1}{9.81} = \text{the work done in kilogrammetres.}$$

As a kilogrammetre per second $= \frac{1}{76}$ horse-power, letting $C =$ number of practical units passing in one second (*i.e.* the strength of the current), we find that

$$\frac{C\,E}{746} = \text{horse-power in the circuit.}$$

From this the significance and the necessity of electric potential become apparent. To get an expression for potential as applied to magnetism, let us take a wire through which a current is passing, and put it through a little hole in a sheet of glass, which is covered with fine iron filings. The filings will arrange themselves concentrically around the wire, proving that the electric current in the wire has magnetic power. The same may be shown by passing such a wire near a magnetic needle. Electric energy and magnetic energy are evidently related, therefore, in some way; so that we may endeavor to get an expression for magnetic potential as related to electric potential.

In order to arrive at this relation, let us bend the wire into a loop. The whirls of magnetic force playing around the wire, will, in the interior of the loop, all lie parallel, so that they will combine in their action. If, now, we bring a magnet pole near this loop, it will be attracted or repelled according to the direction of the current, so that the loop acts like a magnetic shell, that is a sheet of magnetized material, in which the sides are oppositely polarized. Supposing the magnet pole to be a north pole, it will be noticed that it is *repelled* from a loop in which the current runs (as looked at from this north pole) in a direction *contrary* to that of the hands of a watch, and is *attracted* if the current flows in the *same* direction. For convenience of description, a current in the latter direction is called *positive*, the former *negative*.

It is a fundamental proposition, that the potential due at any point to a magnetic shell, is equal to the strength of the shell multiplied by the solid angle it subtends at that point. The potential at the surface of the shell must, therefore, be $2\,\Pi\,i$, in which i represents the strength of the shell, as the solid angle there is $2\,\Pi$.

If now we make a magnetic shell by looping a wire through which a current is passing, the potential in the plane of the loop will be also $2\,\Pi\,i$, in which i represents the strength of the shell produced by the current. In order to get the relation between this strength and the strength of the current, let us make the wire of the loop $2\,\Pi$ long; that is, make it in a circle of one centimetre radius. Remembering that the potential at any point due to a series of poles, is equal to the sum of the potentials due to all the poles, and that the potential at any point due to one pole is equal to the strength of the pole divided by the distance, we see that the potential at the centre of this loop must be $2\,\Pi$, multiplied by the magnetic strength of each centimetre of the loop. Remembering, again, that the force exerted by any pole is inversely as the square of the distance from the pole, we see that if we adopt the convention that a current of unit strength is one such, that if one centimetre of a conductor carrying it be bent into an arc of one centimetre radius, it will exert unit force at the centre, we can express the potential due to a closed voltaic circuit in terms of the strength of the current, by substituting, in the above proposition, "strength of current," for "strength of shell."

But here we must introduce the element of positive and negative signs :

It will be remembered that we found a north pole to be repelled by a negative current. As the north pole was thus repelled, it had a certain positive potential, or power to do work. Positive potential is, therefore, associated with negative current.

In applying the proposition, therefore, concerning magnetic shells to closed voltaic circuits, we must not neglect the signs.

The potential due to any closed voltaic circuit, therefore, is equal to the product of the solid angle it subtends into the strength of current taken with a negative sign.

If A equals this angle, and $+C$ is the strength of the current, the potential is $-AC$. The negative sign indicates negative potential, *i. e.*, not power to do work, but the reverse. In other words, the magnet pole is attracted, as it would be by a positive current. If the current were $-C$, then the potential would be $-(-AC) = +AC$; in other words, the positive magnet pole is repelled, as it would be by a negative current.

We must not forget, in all these cases, to look at the circuits from the position of the magnet pole.

(*To be continued.*)

EFFICIENCY OF ELECTRICAL MACHINES.

BY CARL HERING.

THERE are several statements made by electricians, in regard to the best distribution of the resistances in a circuit, but they apparently do not agree, and being frequently stated in an indefinite way, often cause considerable confusion. For instance, one engineer states that he can demonstrate mathematically, that, in order that a machine should have the greatest efficiency, the internal resistance must be made equal to the external resistance, because then the amount of work given off is a maximum, and says it is evident that the efficiency will be greatest when the amount of work given off is greatest. This has been published so often, that many accepted it, and built their machines accordingly; it is quite natural that they should be disgusted with scientific and mathematical statements, when they found that the greatest possible efficiency was less than 50 per cent., and that in many cases the machines became objectionably warm. Another engineer makes the statement, that in the above case, as the resistances were equal, the work lost in the machine will be equal to that done in the external circuit, as the work is done there where the resistances are, and that, therefore, the greatest amount of work obtainable from a perfect machine would be only one-half, or 50 per cent. of that used to drive it; but as many machines in use have a greater efficiency than 50 per cent., he says, that notwithstanding the mathematics, there is "something wrong" with the first statement. A third says, that as the work absorbed in a machine, and that given off in the external circuit, are respectively proportional to the internal and external resistances, that, therefore, the greatest efficiency is obtained when the internal resistance is made small, and the external resistance made larger. He also claims that he can demonstrate it mathematically; but as the first and last statements appear to contradict each other, and as they can both be demonstrated mathematically, there must be some fallacy in the statements, for what is mathematically true, cannot possibly be incorrect. An explanation of what these statements really mean, how they can be demonstrated, and with what limitations they should be applied, is the object of the present discussion.

Let E be the electro-motive force of the machine or battery.

$R_{,}$ the external resistance.
$R_{,,}$ the internal resistance.
R the total resistance.
C the current strength.
w the work in the external circuit.
$w_{,}$ the work absorbed in the internal circuit.
W the total work of the current.

The following will be evident:

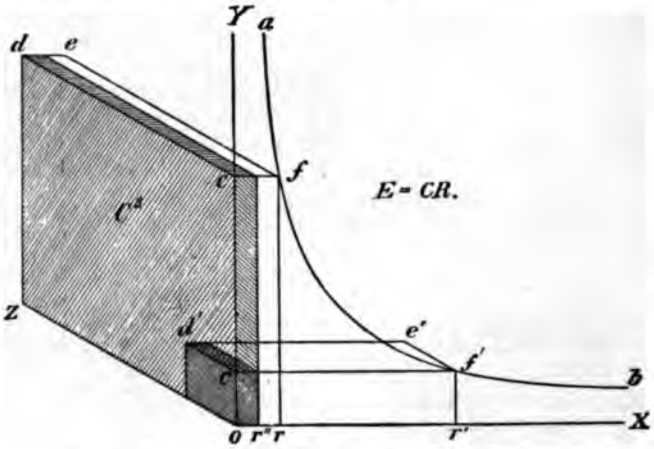
$$C = \frac{E}{R} \qquad R = R_{,} + R_{,,} \qquad W^* = CE = C^2R = \frac{E^2}{R}$$

As the work consumed in any portion of a circuit is equal to the resistance of that portion multiplied by the square of the current strength, it follows that

$$w = C^2R_{,} \qquad w_{,} = C^2R_{,,} \qquad W = w + w_{,} = C^2(R_{,} + R_{,,})$$

w representing the useful work, and $w_{,}$ the lost work.

In order to examine the above mentioned statements, let us first see what the relations between the different quantities are, by representing them graphically, as that shows them much more clearly than algebraic formulæ.



In the diagram let the resistances be laid off on the line OX, and the current strengths on the lines OY and OZ (the latter being in perspective). From Ohm's law

$$C = \frac{E}{R} \text{ or } E = CR$$

which shows that if E is a constant, which we will assume at present, then the curve representing the relation between the corresponding values of C and R, will be an equilateral hyperbola. Let $a\ b$ be this curve, for the assumed value of E, then for any resistance, such as $o\ r = R$, the current strength will be represented by the perpendicular $r\ f = o\ c$. If the values of C be laid off on $O\ Z$ also, and a square constructed on the two as sides, its area will represent C^2, and if this is multiplied by the corresponding value of $R = o\ r$, then the solid $O\ Z\ d\ c\ e\ f\ r$, etc. will represent C^2R, or the total work of the current. If $o\ r''$ is the internal resistance, and $o\ r$ the total, therefore $r''\ r$ the external, then the two solids constructed on C^2 will show very clearly the lost work (the shaded portion), and the useful work (the light portion), and what proportion one is of the other.

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[*] As the factor "time" is not necessary in the demonstration, it will be neglected, that is, it may be considered unity; therefore the terms "power" and "work" can be used indiscriminately. *Volt-ampères*, which really represent *power*, will therefore be called *work*, as it is thought that it will then be more easily understood.

Let us assume a certain internal resistance, equal to $o\,r''$, and see what the different amounts of work will be for different external resistances, as $r''\,r$ and $r''\,r'$. It will be seen from the diagram, that as the external resistance increases, the *total amount* of work of the circuit becomes less, but at the same time the percentage of lost work decreases very rapidly, as $o\,r''$ remains the same; that is, the *efficiency is increased;* it is a maximum only when $R = \infty$ or $R_{\prime\prime} = 0$, neither of which are possible. When the external resistance decreases to $r''\,r$, the *amount of work* increases very rapidly, but as the internal resistance remains the same, the lost work also increases very rapidly, and the percentage of loss becomes much greater; finally, when the total resistance is equal to the internal, that is, the external $= 0$, the machine is short circuited, and all the work, which is then at a maximum, is consumed in itself, and appears as heat. It will be seen, therefore, that for a constant value of the internal resistance, and a decreasing external resistance, the amount of work will increase, but the percentage of loss also, the latter more rapidly than the former, from which it follows, that for a certain value of the external resistance the *amount of useful work* is a maximum; this is, as will be demonstrated, when the internal is equal to the external, as drawn in the diagram, in which $r''\,r = o\,r''$. As $O\,Z\,d\,c\,e\,f\,r$, etc., represents the total work, and the shaded portion the lost work, it follows that the useful work $W - w$, is equal to ½ W, or in other words, *when a theoretically perfect machine is converting the greatest possible amount of work into useful work, its efficiency is only* 50 *per cent.*, and as much work is converted into heat in the machine itself, as appears as useful work outside. From this it may be seen, that when an inventor claims that with the above arrangement of resistances, he has obtained 70 or 80 per cent. efficiency, he is, to put it in mild terms—mistaking.

The diagram also shows that the work depends very much on the position of the curve, but this depends on E, and becomes flatter, and moves upward and to the right as E increases. No change of E, however, will change the efficiency.

The mathematical demonstration of what was illustrated in the diagram, is very simple. As

$$w = C^2 R_{\prime} \text{ and } W = C^2 R$$

$$\text{efficiency} = \frac{w}{W} = \frac{R_{\prime}}{R} = \frac{R_{\prime}}{R_{\prime} + R_{\prime\prime}}$$

That is, *the efficiency is independent of E; it depends only upon the ratio of the external to the total resistances*, and can evidently be increased by increasing $R_{\prime}$ or diminishing $R_{\prime\prime}$. As

$$w = C^2 R_{\prime} \text{ and } C = \frac{E}{R} = \frac{E}{R_{\prime} + R_{\prime\prime}}.$$

therefore,

$$w = \frac{E^2 R_{\prime}}{(R_{\prime} + R_{\prime\prime})^{2}}$$

which by the aid of calculus can be shown to be a maximum when $R_{\prime} = R_{\prime\prime}$. To prove this by algebra, solve the equation for $R_{\prime}$ which gives

$$R_{\prime} = \frac{E^2}{2\,w}\left(1 + \sqrt{1 - \frac{4\,R_{\prime\prime}\,w}{E^2}}\right) - R_{\prime\prime}$$

from which it can be seen that the greatest value which w can have for real values of $R_{\prime}$ is when it makes the quantity under the radical 0, that is, when

$$1 - \frac{4\,R_{\prime\prime}\,w}{E^2} = 0$$

or

$$w = \frac{E^2}{4\,R_{\prime\prime}}$$

substituting this value of w in the value of $R_{\prime}$ gives, after a simple reduction,

$$R_{\prime} = R_{\prime\prime}$$

that is, w is greatest when the external and internal resistances are equal. But as $R = R_{\prime} + R_{\prime\prime}$ this value of $R_{\prime}$ makes

$$W = \frac{E^2}{R} = \frac{E^2}{2\,R_{\prime\prime}} \text{ and } \frac{w}{W} = \frac{E^2}{4\,R_{\prime\prime}} \div \frac{E^2}{2\,R_{\prime\prime}} = \tfrac{1}{2}$$

that is, the efficiency is then 50 per cent.

The above discussion is applicable only when there is no counter electro-motive force in the external circuit. When there are electro-motors, accumulators, electro-plating baths, etc., in the circuit, developing a reverse electro-motive force, the statements must be changed slightly. This case will be discussed in another article.

To recapitulate: for a given total resistance the *efficiency* of a machine is increased as the ratio of the external to the total resistance is increased; and for a given internal resistance it increases rapidly with the external resistance; it is a maximum, that is, unity or 100 per cent., only when the internal resistance is 0, or the external ∞, and the machine a perfect one. The *greatest amount* of work obtainable from a machine, is when the external and internal resistance are equal, and then it is only one-half of the work used to drive it. In both cases the *total work increases with the square of the electro-motive force*, but the *efficiency is independent of the electro-motive force.*

These statements are not contradictory, as might be at first supposed; for instance, if we wanted a machine to do a certain amount of work, we would select one capable of doing much more than the required amount, and by making the external resistance high, use only a part of the work it is capable of furnishing, and thus obtain a higher efficiency. As the price increases with the size, and at the same time the percentage of loss decreases, the question of how powerful a one to choose, depends upon so many quantities, that it would be impossible to calculate the limit theoretically. Having given the constants, dimensions, and price of each machine, and the cost of the power, any electrical engineer can make the necessary calculations, to show which one would be the most economical for a given amount of work to be performed. If power is cheap, use a machine which, when working at its maximum rate (*i e.*, external resistance equals internal), will do the required electrical work. If power is expensive, use one much more powerful (*i.e.*, capable of doing more work, if working at its maximum rate), the limit being, when the increased price becomes greater than the saving by increased efficiency, remembering to make the ratio of the external to the total resistance as great as possible.

To illustrate this with an example, let a power of 17,640 volt-ampéres be required, and let a certain machine give an electro-motive force of 840 volts, and have an internal resistance of 10 ohms. If the external circuit is arranged to have a resistance equal to 10 ohms, that is, equal to the internal resistance, the machine will just perform the work, for

$$w = \frac{E^2}{4\,R_{\prime}} = \frac{(840)^2}{40} = 17{,}640 \text{ volt-ampéres,}$$

and considering the machine perfect, the efficiency will be 50 per cent., and the power used to drive it will be 35,280 volt-ampéres, or its equivalent in horse-power.

Taking two such machines in multiple arc, which is equivalent to one twice as large, with the same electro-motive force, but with one-half the internal resistance, and changing the external resistance to about 29 ohms, the power obtained will be

$$w = C^2 R_{\prime} = \frac{E^2 R_{\prime}}{(R_{\prime} + R_{\prime\prime})^2} = \frac{(840)^2\,29}{(29 + 5)^2} = 17{,}640 \text{ v. a.,}$$

the same as before. The work required will be

$$W = \frac{E^2}{R_{,} + R_{,,}} = \frac{(840)^2}{29 + 5} = 20{,}748 \text{ volt-ampéres,}$$

and the efficiency

$$\frac{w}{W} = \frac{17{,}640}{20{,}748} = \frac{29 \text{ ohms}}{34 \text{ ohms}} = 85 \text{ per cent.,}$$

very much greater than before. The ratio of the power used to drive them in both cases, will be

$$\frac{20{,}748}{35{,}280} = 59 \text{ per cent.,}$$

showing that only 59 per cent. of the power is required in the second case to do the same work. If the 41 per cent. of power saved is worth more than the interest, etc., on the second machine, it will be more profitable to use two, or one twice as powerful, besides avoiding heating of the armature.

Vienna, October 28th, 1883.

OUR PARIS CORRESPONDENCE.

PARIS, Nov. 1st, 1883.

TELEPHONIC communication between cities that are only a few kilometres distant from each other, has been very rapidly developed in the United States, according to the papers. It was a natural application that was thoroughly comprehended from the first in the country of Graham Bell, but it has not yet received the development in Europe that it is entitled to. Some successful endeavors have been made in England; in Belgium, the Bell Telephone Company has only just obtained the necessary permission to connect a certain number of towns and important localities. There is no talk at all about the matter in France, and with all the administrative formalities, the question is not an easy one to solve. The telephonic system has been very successfully tried in Alsace, and, as usual, the city of Mulhouse owes a debt to the *Société Industrielle*, which took the initiative in procuring for it the advantages of the wonderful invention.

It is scarcely two years since the first telephones were put up in the city, and now the persons who use them acknowledge that they have become as indispensable as the telegraph. The increase in the number of subscribers proves how much these services are appreciated: in the beginning, in January, 1881 there were some seventy subscribers; there are 125 at present, and communication is not restricted to the city, but extends to the neighboring localities: Ile Napoleon, Modenheim, and Sausheim, which are connected with the principal system. During the first year the number of telephonic messages hardly reached 200 a day; they are at present 300, and some days reach the figure of 600.

A telephonic system was established at Guebwiller during 1882, and was extended to the neighboring towns of Issenheim, Bull, Lautenbach, Jungholz and Wuenheim. The number of subscribers was twenty-four, but the system was connected on December 5, 1882 with that of Mulhouse, which increases its importance. There are about twenty messages a day between the two cities, but this is only the beginning. The subscription price both in Mulhouse and Guebwiller is 250 francs per annum. When messages have to pass from one system to another each message is paid by the sender separately, and costs twenty-five centimes, (five cents).

The use of the telephone will be generalized in a short time by the success of this extension. Cernay, Thann and Altkirch in Alsace, and Basle in Switzerland will constitute a system of which Mulhouse will be the centre.

According to the regulations of the German posts and telegraphs, the administration undertakes to put up systems with all the apparatus, &c requisite, but the lines connecting one system with another must be established at the cost of the interested parties, and this was done in the case of the connecting line between Mulhouse and Guebwiller. The length is some twenty kilometres ($12\frac{1}{2}$ miles). The cost was 11,000 francs, or some 500 francs per kilometre. The expenses were as follows:

Fifteen to twenty posts	200	francs.
Iron wire of four millimetres	50	"
Insulators, (15 to 20)	25	"
Bearers, screws and fastenings	25	"
Labor	100	"
Overseers of work	40	"
General expenses, fares, &c	60	"
	500	francs.

This first attempt will doubtless decide the German administration to take under its charge connecting lines, without waiting for the interested parties to come to an agreement among themselves as to the payment of the cost. It would be very easy to cover the interest of the capital employed by increasing the subscription rates, and the simplification of the matter would naturally increase the use of the telephone.

Zurich can, in this respect, be cited as a model. There are four subscription rates, 100, 160, 200 and 250 francs, according to the length of the line and the use of the instrument. The average rate is 135 francs. Distant subscribers, outside the regular zone, pay an additional rate of five francs per kilometre. The lowness of the tariffs and their grading are one of the causes of the rapid development of the system, which must soon be greatly extended. It is designed, in fact, to connect all the localities that are in business relations with Zurich, as Winterthur, Thalweil, &c., and to organize connections over a surface of 300 square kilometres, wherein the distance of the furthest point would be thirty kilometres. The credit for the successful results thus obtained must be given to the capable management of the Zurich Telephone Company.

I have already written about the advantages that might be had for telephonic and telegraphic communication by using the silicon bronze wires of M. Lazare Weiller. Although this was a personal opinion, I am at present glad to say that I can support it by an official one, as now a line of 1,000 kilometres is going to be put up with them, and this is a distance that exceeds in general, the direct lines of private companies in France The comparison between the galvanized iron wire hitherto adopted, and the silicon bronze that can do the same work, is sufficiently interesting and novel to allow me entering into some precise details on the subject.

ESTIMATE FOR PUTTING UP 1,000 KILOMETRES OF WIRE.

1st.—Galvanized iron wire of 5 millimetres in diameter.

	francs.
The iron wire will weigh 156 kilos per kilometre, or 156 tons altogether @ 38 francs per 1,000 kilos	59,280
Transported to works, 156 tons @ 20 fr.	3,120
Bearers and insulators 15 per kilometre @ 2 fr.	30,000
Putting up supports, unwinding and putting up and gauging, &c. @ 10 fr. per kilometre	10,000
Two-thirds of the rests must be supported by double posts: 15 rests per kilometre represent 25 single poles @ 12 fr.—25000 x12	300,000
Bringing poles to place @ 1 fr.	25,000
Putting down, single poles 5x1000 @ 2 fr.	10,000
" " double poles, 10x1000 @ 4 fr.	40,000
Bringing 10,000 double poles at 2 fr.	20,000
Total francs	497,400

2d.—Silicon bronze wires of two millimetres in diameter, having electric resistance equal to that of the iron wire of five millimetres, and a resistance against fracture, per square millimetre, superior to that of the iron wire.

The bronze wire weighs 28 kilos per kilometre, and costs 4 francs per kilo, 28x1000	112.000
Freight to works, 28 tons @ 20 fr	560
Supports and insulators, 12 per kilometre @ 1 fr.	12,000
Putting up supports, mounting, unrolling, &c. at 4 fr. per kilometre	4,000
One-third of the rests will be consolidated, either by having 8 single poles and 4 double, per kilometre—16 poles @ 10 fr.	160,000
Cost of bringing 16,000 poles to work @ 1 fr.	16,000
Putting down 8,000 single poles @ 2 fr.	16,000
Putting down 4,000 double poles @ 4 fr.	16,000
Bringing 4,000 double poles @ 2 fr.	8,000
Total francs	344.560

From the above figures, the accuracy of which can be easily tested, it results that while the galvanized iron would come to 497 francs (40 c,) and the silicon bronze to 344 francs (56 c.) per kilometre, the latter would procure a saving of more than thirty per cent., owing more especially that its lightness and resistance to fracture allow of greater spans, and diminish at the same time the number and the price of the poles and supports.

The silicon bronze wire is already used successfully on a certain number of telephonic lines. In Rheims, for instance, and in Italy especially; and it has been given the preference to galvanized iron in the recent experiments of transmission of power at Grenoble. We will not return to the results obtained. Some persons are inclined to impute to ignorance or unworthy motives the criticisms addressed to M. Marcel Deprez.

Under such circumstances, I think it is better not to discuss the matter, I will confine myself to observing that the transmission of power to a distance of fourteen kilometres, is a very remarkable experiment, but that it proves nothing from an industrial point of view. There is some talk of repeating the experiments on a far larger scale. A power of 500 horses would be taken at the starting point, and fifty per cent. of this would be sent a distance of fifty kilometres, and would be distributed among a dozen of real or artificial establishments, at the rate of twenty-five horses on an average for each. It would be quite natural that M. Deprez should accept the challenge, no one is better able to take it up; we shall be heartily glad when the success of it may be proved, but until it be, we shall take the liberty of doubting, and of believing that the problem thus laid down, will not be so soon solved.

I am not alone, either, in having this opinion, while I can support it, perhaps more than others, from the experiments of capable electricians. Engineers, whose competency and impartiality cannot be questioned, have recently examined various methods for transmitting a power to a distance, so as to utilize a water power of several thousand horses. The object was to store the power produced by the Rhone at its issue from the Lake of Geneva. The conditions were most favorable, as there were a great population, and numerous factories within a radius of three or four kilometres, and which only wanted to make use of the power. M. Legler, an engineer, who is well known for the works he executed in the Valley of the Luith; M. Achard, who has for years taken an interest in the question of transmitting power, and M. Turettini, who is at the head of a large machine shop in Geneva, and well acquainted with the progress of electricity, have drawn up a combined statement, the merit of which we need not go into. Among other points they had to discuss the various methods of transmitting power, and justify any final choice that might be made. The analysis of this part of the work would be out of place here, but we think it will be useful to summarize the observations concerning electricity.

The loss of the product with electricity arises from three principal causes: the heating caused by the resistance of the primary or generative machine, the heating caused by the resistance of the intermediary conductor, and that caused by the resistance of the secondary machine. These three factors, to which there are reasons for adding the friction—relatively feeble however—of the two machines, are the principal causes of the loss of the product, a loss which is not to be made light of; for, in the celebrated experiments of M. Marcel Deprez, at Munich, and in the station of the Northern Railway, in Paris, they reached together about seventy per cent, leaving only some thirty per cent. as an effective.

"It is proper to state," adds M. Turrettini, "that M. Marcel Deprez greatly added to the difficulties of his experiments, as if on purpose, by using iron cables (consequently of enormous resistance), and by trying to produce a difference of potential of several thousand volts in a single machine, which made it exceedingly delicate, and reduced the return obtained by a great proportion, on account of the insufficient insulation of the wires of his machine, when having to do with such enormous differences of tension."

The distance to which the transmission was sent in Paris was 8,500 metres, and it is hardly likely that there are such long transmissions in Geneva; the problem would be, therefore, simplified. But, the question of the electro-motive power remained—from the physiological point of view—that is to say, of accidents to the person. It appears that we may go as far as a tension of 500 volts, and machines are now built in France and Germany that produce that tension; they are built for industrial purposes, and give a return of eighty per cent, either for the generator or the receiving machine. The final return is, therefore, sixty-four per cent., and if ten per cent is added for the cable bringing the electricity from one machine to the other, we arrive at an effective return of fifty-four per cent on the driving shaft of the receiving machine. With a machine producing a tension of 500 volts, and an intensity of fifty ampéres, which is equivalent in electric energy to 2,500 volt-ampéres (2,500 kilogrammetres, or thirty-three horses), it is asserted that we may obtain at a distance of 1,000 metres a power of twenty-three horse on the shaft of the generating machine—a copper cable to be used, having a resistance of 0.50 ohm per kilometre, and costing with its lead casing 2,500 francs per kilometre. (We must point out, however, that the calculations based on the preceding *data* would give only nineteen horses instead of twenty-three). According to M Turettini, the price of two machines and two kilometres of cable, (for both ways), would not exceed 15,000 francs, and counting fifteen per cent for interest and sinking fund, the price per horse per annum would be about 100 francs.

A reference to what I have previously written on this subject, will show that I have never said anything else on the matter. The transmission of power by electricity has not yet left the experimental stage. In Geneva, transmission by hydraulic pressure has been selected, not but that it has its defects, but because it allows us to satisfy, at the same time, domestic requirements and those of industry. This instance shows, too, that consideration which not at all of an industrial character, may in certain cases compel the adoption of some system, no matter how costly the first putting up may be.

I wrote you that the Compagnie Electrique, of Paris, would probably send to the Vienna Exposition a lot of machines for the transmission of great power, invented by M. Gramme. These machines have been working for a month past – they are employed to feed the waterfall in the centre of the rotunda, by means of a Dumont centrifugal pump. The distance between the two machines is 100 metres. The interest of the matter is not in the distance, but in the power developed by the receiver; from twenty-five to thirty horse. This is the first time that electric machines of this power have been shown at regular and continuous work. It is a new success scored by M. Gramme. The *savants* at the exposition will not fail to measure the different elements of these new machines, and we will wait the result of their researches before entering more fully into the subject, and citing some indisputable figures.

The Faure accumulators, and M. Phillipart's enterprise are almost forgotten in Paris. The French character does not like to remain long on the same subject, and curiosity in this case soon grew less Will the Société Métropolitaine Electrique (as it is now called) easily find bankers ready to take its issue? Everything depends on this, and the delays at present attending this issue would lead one to suppose that matters are not going on smoothly. In the meantime, M. Phillipart distributes prospectuses, in which he proposes accumulators for illuminating, and giving motive power at home, at the following rates:

Lamp of 6 candles, per hour	8 centimes.
" 12 " "	14 "
" 20 " "	20 "

These prices are altogether above the price for gas, and we do not see that there are any grounds for counting upon a large consumption, even in Paris *motive power*.

2.5 kilogrammetres, per working hour	15 centimes.
5 " " "	25 "
10 " " "	40 "
20 " " "	60 "
30 " " "	75 "

These rates are also above those of a gas motor, as soon as we arrive at ten kilogrammetres, and the pay of a workman for small power (pedal or crank). At any rate nothing is done for less than thirty working hours per week of effective work, and for less than a year. Even under these conditions, if we consider the working expenses, freight, handling and charging the accumulators, and the general expenses, it will be easily seen that the undertaking cannot be a profitable one.

PH. DELAHAYE.

I have just learned that Messrs de Rothschild have made arrangements with the French syndicate of electricity, which owns M. Marcel Deprez's patents. It is a success on which we may congratulate ourselves from the electric point of view. The credit undoubtedly belongs to Dr. Herz, who has displayed for years his remarkable talent in trying to accomplish the electric transmission of power to a distance.

OUR VIENNA CORRESPONDENCE.

VIENNA, November 1st, 1883.

WHEN the Exhibition first opened there were no new forms of electrical machines, and it seemed as if that branch of the exhibition would have little interest to the electrician; but toward the close, many more were added, among which are some new and very interesting ones, besides improved forms of older ones, so that now the machines are one of the greatest attractions of the exhibition. In regard to the efficiency of the machines, and other data about them, we were unable to obtain any reliable figures, notwithstanding our frequent inquiry; the persons in charge of many of the exhibits either did not wish to give it, or else did not know it themselves—which, we are sorry to say, was frequently the case—or else they gave some figures which a short calculation showed to be incorrect The "scientific committees,' which take the place of the jury here, made very elaborate tests of many of the machines, in which they measured accurately the mechanical energy consumed in the machine while running on open circuit, and then while running at various different speeds on closed circuit, at the same time measuring the electro-motive force, the current strength and all the resistances. When they have completed and published their results it will be, besides the Munich report, the only reliable and accurate collection of data about the various different machines, and will enable the electrical engineer to select from it the best machines for different purposes.

Taking first the constant current machines, by far the greater number use either the Gramme, Hefner-Altenck, or the Brush (Schnckert) armatures, or modifications of them. Of the Gramme type there are the following: Gramme, old and new forms, Ducommun, Egger and Kremenezky, Maxim, Schwerd, Jüngers, Kröttlinger, Bürgin and Crompton, and Gravier (small). The old Gramme needs no further description. The new form consist of from 6 to 12 long cylindrical magnets arranged parallel to each other in the form of a large horizontal cylinder, half of them terminate in one North pole piece, and half in the South pole piece; between these semi-cylindrical pole pieces the Gramme ring revolves. They are used principally for the transmission of power. The Ducommun are Gramme of the old type; they are without doubt the most accurately made and most neatly finished machines here; indeed if one does not look at the belt one would not think the machine was running Those of Egger and Kremenezky have long horizontal oval magnets like in the Weston machines; a good feature is that the brass bearings for the armature are fastened directly to the pole pieces, thus assuring concentricity. The Maxim are the same as those used in the United States The Schwerd have low flat horizontal magnets, like the Weston; their principal feature is that the pole pieces of the magnets are extended around the ends of the ring and to a greater part of the inside, thus having much less dead wire on the armature than the ordinary Gramme ring. The Jüngers (Denmark) has a very odd appearance, having the magnets in the form of two quadrants in a vertical plane, the lower parts terminating in the base, while the upper parts terminate in the pole shoes between which the ring revolves; its principal improvement is that it has a fixed electro-magnet inside of the ring, thus diminishing the dead wire very much. The Kröttinger machines have perforated circular discs of sheet iron fastened to the outside of the ring to cause a circulation of the air through the armature. In the Bürgin and Crompton, the ring is separated into 8 or 10 smaller hexagonal parts, thus allowing the air to circulate freely, but increasing the amount of dead wire. The brass bearings are fastened directly to the pole pieces, assuring concentricity and allowing the armature to be removed in a few minutes; from a mechanical point of view, it is the best built machine here. The small Gravier has horizontal magnets, the two extreme ends of which are connected by four stout pieces of iron two of which serve to hold the bearings.

Of those using the Hefner-Altenck armature there are the following: Siemens, Weston, Edison, and Ganz. Those of Siemens and Halske need no further description, except that many of the new ones are "compound," that is, the magnets are wrapped with a fine wire in shunt circuit with the external circuit, and with coarse wire in the main circuit; the object of this construction being to make them self-regulating for a variable external circuit. The principle is explained as follows: if the external circuit is increased, for instance by turning off incandescent lights, less current will go through the coarse wire around the magnets; but as the fine wire is in multiple arc with the external circuit, more current will go through it if the external resistance is increased, thus keeping the magnetism of the machine constant or nearly so, and as the speed remains constant the electro-motive force of the current will remain the same, no matter how much current is used in the external circuit; it is therefore self-regulating between certain limits. Sometimes two of the four magnets are wound with fine wire, and two with coarse, and sometimes each magnet has two windings. The Weston and Edison machines are also well known in the United States, and need no further description. The latter are characterized by their clumsy appearance and want of finish, but at the same time will probably prove to be among the most efficient of those exhibited here. A machine used by Ganz contains 8 magnets radiating around the armature and terminating in four quarter circle pole pieces, thus being a sort of double Siemens' machine; it is used to excite the large alternating current machine.

Those containing the Brush or Schuckert ring armature are the following: Brush (2 forms), Schuckert, Gravier, Spieker and Egger, and Kremenezky. The ordinary form of Brush for tension currents is the same as that used in the United States. The other called the Brush–Schuckert, used for quantity currents, is similar in principle, only that it consists of four magnets on each side, and that the Schuckert ring armature is used. Although there are four sets of poles, the connections of the commutator and the wire on the ring are so made that only two brushes are required. The Schuckert armature is a ring similar to the Brush in principle, only that it is made of thin perforated sheet iron rings, magnetically insulated from each other by discs of zinc, the object of which is to allow the magnetism to change more easily and rapidly. The bundle of rings is wrapped continuously with wire forming a uniform ring; the connections of the wire and the commutator are made as in the ordinary Gramme ring. The magnets and pole pieces in the Schuckert machines are similar to those of the Brush, only that they are round and in a vertical plane. Those used for incandescent are also made "compound" as the Siemens' machines above described. The Schuckert machines constitute a very large portion of all those here, and seem to be very satisfactory. Next to the Gramme and Siemens, it is probably the most frequently used machine in Europe. They are invariably painted a bright green, just as the Brush are always red and the Siemens black. A Schuckert machine was used by the scientific committees for testing the lights, and proved very satisfactory.

The Spieker, and the other Egger and Kremenezky machines are imitation Schuckert machines. In the Gravier the ring is made very thin and broad, being only about one inch thick; the wire is replaced by copper bars to diminish the resistance, and the magnets are made of a large number of small short magnets placed in a circle on both sides of the ring. The principle of the latter seems to be very good, but unfortunately the machine has not been running yet.

Of the other machines the most interesting is the Elfinstone and Vincent, * of which this is the first public exhibition The armature consists of a large hollow cylinder of *papier mâché*, in the surface of which are fastened many large rectangles of wire, the distance between the long sides of the rectangles being $\frac{1}{6}$ of the circumference. Inside of the armature are 6 radial magnets with alternate North and South poles toward the armature; on the outside of the armature are six more magnets whose holes terminate directly opposite those on the inside, but are of opposite name, so that 6 very intense magnetic fields are produced, through which the wire on the drum passes. From the theory of induced currents it will readily be seen that if a current is produced in one direction in one side of a rectangle, it will be produced in the opposite direction in the other side as the poles alternate; the current will, therefore, be in the same direction around the periphery of the rectangles, or in the whole circuit. It is one of the few machines, if not the only one, in which the field is produced by two *unlike* poles of two electro-magnets, and which has no iron in the armature. The steam engine driving it was indicated a few days ago and showed a consumption of 35 horse-power when the machine was running 400 lights of 16–20 candles, or over 11 lamps per horse-power, the best result, we believe, which has yet been obtained in practice.

Another machine of interest is the Chertemps. It consists of 6 bobbins with horizontal axis, arranged and fixed in a vertical circle; on both sides are six electro-magnets, whose outside ends are fastened to two iron discs which are fixed to the axis. The six magnets on each side are made to revolve; passing by the six coils just as in the Siemens alternating current machine, or the Ferranti, only that in the latter two the coils revolve and the magnets are fixed. The magnet coils are connected with the six commutator strips in such a way, that if the alternating current from the coils is led to the brushes, the current in each magnet remains in the same direction. One coil is thus connected with the magnets and supplies them, while the alternating current from the other five coils is used in the external circuit. It is thus an alternating current machine which excites itself. By connecting all the coils together and passing the whole current through the magnets, and then through two brushes to the lamps, the current is continuous. Thus the same machine may be used for alternating or continuous currents by simply changing the connections. As the coils terminate in separate binding posts, they may be connected for quantity or tension. The attendant remarked that it was the only machine which could be short circuited, which he illustrated by laying a screw driver over the poles of the coils—the lights all went out and the machine ran loose. The explanation is very simple, because when the coils are short circuited no current goes into the magnets, and, therefore, the magnets cannot induce any current in the coils.

Of the alternating current machines there are the following: Siemens, Ferranti, Gramme, Ganz and Klimenkow. The first three are all well known, and need not be described here. The Ganz is a copy of an old form of Siemens, which was discarded by that firm several years ago, and an old form of which is exhibited by that rival firm as an historical relic. It consists of numerous flat coils, arranged parallel to each other along the circumference of a circle, with their axis radiating toward the centre; inside of this circle are as many radiating electro-magnets as there are coils on the outside; the poles at the free ends being alternately North and South. These magnets are made to revolve, and it is easily seen will produce a current in the coils every time a magnet passes a coil. Iron wire is wrapped around the outside of the coils, and acts as the soft iron magnet. There is a large one of this type, the diameter of which is about 10 feet, and is, therefore, termed the "baby." It contains 36 magnets, and is said to supply 2,000 lights in the theatre and its approaches, while consuming only 120 horse-power. The magnets and their frame form the fly wheel of the large engine, which is coupled on the same shaft with it. In the inside of the ring of magnets are two circles of 12 magnets each, radiating toward the centre, with like poles toward each other; between these a Gramme ring revolves, the current from which was intended to supply the electro-magnets, but owing to some unfortunate circumstance, this part does not work, so that another machine has to be used to excite the magnets.

The Klimenkow machine is difficult to describe without a drawing; we will be able to give simply the principle of its construction. There are numerous coils with iron cores arranged parallel to each other in a circle; in the middle is an electro-magnet, whose pole pieces are two iron stars or crosses. This electro-magnet is revolved, the arms of the stars passing by the iron cores of the coils inducing a current every time they pass. These two stars are so set that when one arm of the star of the North pole piece is opposite one end of the coil, the arm of the star of the South pole piece is opposite the other end of the same coil, so as to produce the maximum effect.

* * *

The exhibition will close Sunday evening, November 4. Through the excellent management of its able directors it has been a very great success in every way. Not only has it given the general public an opportunity to see the great progress which electrical engineering has made, and its almost unlimited application, but it has also enabled the electrician to gather a great amount of useful knowledge, and will give him—when the results of the tests of the committee are published—a very valuable set of reliable figures about the most important machines and lamps, from which he will be able to make a fair comparison of their values.

CARL HERING.

—— ONE OF OUR ELECTRICIANS gives us a solution of the rain on Evacuation Day. Mr. Edison informed the court the other day, that electrical wires in rain storms were highly injurious to life. On Evacuation Day the electric lighting and telegraph poles and wires were swarming with boys, who were as thick as sparrows, and yet were not harmed in the least. Providence thus afforded this opportunity of testing the statement of the distinguished professor.

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* Described in *Engineer*, Jan. 5th, 1883.

THE Boston Manufacturers Mutual Fire Insurance Company have issued to their clients, a pamphlet treating of the relative thermic value of various non-conductors for steam pipes, the care of hydrants during freezing weather, and the lubrication of heavy bearings. Under the latter head, reference is made to the utility of attaching thermostats to the journals in a mill, and connecting them in the circuit of an annunciator, so that any undue heating of the journal gives an alarm. In this connection, the pamphlet quotes from the ELECTRICIAN, of last March, an account of a similar device in practical use.

This company insures mills only, and from time to time issue printed instructions based upon their experience, in the matter of fires, acting upon the principle that it is cheapest to prevent a fire rather than to pay for it. This has been exceedingly profitable, and being a mutual company the dividend (at this time 80 per cent) are distributed among the assured in the proportion of the premiums paid. This matter of a return premium, ensures cordial co-operation between the assured and the insurance company.

SPARKS.

— THE DEATH is announced of Prof. Peter T. Riess. whose treatise on frictional electricity—"Die Lehre von Reibungselektricität" has long been a standard work. His researches on ring-figures produced by discharges on the electric air thermometer, and on the phenomena of the return stroke, are well known. His memoirs on electricity were published in a collected form some years ago.

— IT IS expected that some forty decorations will shortly be bestowed in connection with the Vienna Electric Exhibition. Among those whose names are mentioned are Sir William Siemens and Sir William Thomson. The latter will, it is believed, receive the Second Class of the Order of the Iron Crown, which confers on the recipient, under certain conditions, the rank of an Austrian Baron.

— ONE OF THE NOVELTIES at the Vienna Electric Exhibition is the electrical ballet. The chief features of the entertainment are the introduction of electro-magnets, dynamo machines, telegraph apparatus, and telephones, which were dragged on the stage by fantastic goblins, and handled by the graceful danseuses with as much ease as if they were especially trained in the mysteries of electricity. One of the prettiest scenes is the telegraph-polka, which is danced by two ladies in the costume of telegraph boys.

— MR. E. VAN DER VEN has been making some researches on the use of phosphor bronze and silicon bronze wires for lines, the practical results of which are that their resistances compared with copper of the same diameter are: Phosphor bronze, 30 per cent.; silicon bronze, 70 per cent.; steel being 10.5 per cent. The stretch that can be given from pole to pole is, for steel, 2mm. diameter, 130 ft.; phosphor bronze or silicon bronze, 1 mm. diameter, 106 ft. and 91 ft. respectively. It is assumed that a bronze wire, on account of its elasticity, would coil up before it had fallen far if broken, thus preventing accidents from broken wires.—*Engineering.*

BUSINESS NOTICES.

TO THE PUBLIC.

Office of
THE ELECTRIC GAS LIGHTING CO.,
45 Milk Street,

BOSTON, Mass , Oct. 25, 1883.

NOTICE is hereby given that the contract heretofore existing between this company and The Electrical Supply Company of Ansonia, Conn., whereby the latter was licensed to manufacture and sell ELECTRIC GAS LIGHTING APPARATUS, under the patents owned by the former, was canceled by this company on the 20th day of September, 1883, for non-fulfillment and violation of its terms, conditions and covenants, on the part of said Electrical Supply Company.

Any manufacture or sale of said apparatus by said Electrical Supply Company, since the cancellation of said contract, is an infringement of the patents, and in violation of the rights of this company, and all parties who shall sell, purchase or use said apparatus, thus manufactured, will be held responsible. We have perfected arrangements for the prompt construction of the apparatus by manufacturing electricians who have had extended practical experience in this line of work, thus insuring the production of properly made and perfect working burners, which we shall supply to our agents and patrons in full confidence that they will give entire satisfaction.

We regret the interruption and delay which has been occasioned by the action of The Electrical Supply Company, but its failure to furnish the apparatus according to contract, and the small amount which it did furnish while said contract was in force, was so defective in construction and inferior in quality, that it became our imperative duty to ourselves and our patrons, to exercise our right to terminate the contract for breach of its conditions.

THE ELECTRIC GAS LIGHTING CO.,
by Louis W. Burnham, President & Business Manager.

BINDERS FOR THE ELECTRICIAN.

COMMON-SENSE Binders, of suitable size for one volume, price one dollar each, postage paid.

WILLIAMS & CO.,
115 Nassau Street, New York.

WANTED—A set of Vol. 1 ELECTRICIAN in clean condition. State lowest price. Address Sam'l S. Green, Free Public Library, Worcester, Mass.

A Competent Engineer now employed by an electric light company, in the South, running a high speed engine, wishes to make a change. Address, A. B. C., office of this paper.

WANTED.—A situation as Superintendent with an electric lighting company. The advertiser has had experience in lighting from central station and by isolated plants (arc and incandescent). Address, S. A. E., this office.

THE ELECTRICAL CABINET, an appropriate holiday present for young people. It is little more than a foot square, and contains an electrical plate machine of wonderful capacity, electrical balls, orrery, pith-balls, electrometer, cannon, head of Medusa, Leyden jar, discharger, spiral tube, vacuum tube, box of amalgam, chain, and an elementary guide in electricity. It is eminently adapted to giving instructive and amusing entertainment to young and old alike. See adv't., C. W. Meyer, 11 Dey St., N. Y.

E. & F. N. SPON have just issued a biographical sketch of Philipp Reis, inventor of the telephone; with documentary testimony, translations of the original papers of the inventor and contemporary publications. The volume is compiled by Sylvanus P. Thompson, Professor of Experimental Physics in University College, Bristol, who says in concluding the sketch "If mere mechanical imperfections do not make an invention any the less a true invention, it would be dishonest to deny to Philipp Reis the honor of the invention, of which he openly stated the successes and the imperfections." The volume is illustrated by explanatory engravings showing the original Reis telephones with all their details of construction. Copies of above, price $3.00, as well as any of the latest books on electricity, can be obtained at 35 Murray Street, New York, or will be sent free by mail on receipt of price.

THE ELECTRIC GAS LIGHTING CO. of Boston, have entered into contracts with competent and responsible manufacturers, to get up their burners as quickly as possible. These contracts cover the ownership of the dies and tools, thus leaving the way open for them to undertake the manufacture of their own goods at any time it may appear for their interest to do so.

These new arrangements have been made with the determination to produce the finest and most practical line of *electric gas lighting devices extant*, which are being made under the direct supervision of first-class manufacturing electricians who have had years of practical experience in this line of work, thus insuring the production of properly made and perfect working burners

They expect to begin to furnish licenses, with at least one style of automatic, and four styles of pendant burners, on or before the 15th day of December; and a full supply of all the varieties will be ready for the trade at an early day. Address

LOUIS W. BURNHAM, Prest.,
45 Milk St., Boston, Mass.

THE PHOSPHOR-BRONZE SMELTING CO., Limited, of Philadelphia, are now prepared to furnish phosphor-bronze insulated wires for telephone, district telegraph, telegraph, and similar service, which possess very valuable advantages over the covered iron wires now in use for such purposes.

The high tensile strength of phosphor-bronze wires renders them capable of supporting the extra weight of the coating without undue strain or stretching; their low resistance, which is only about one-half that of iron wires of same weight per mile, makes it possible to use wires only one-half as large for lines of the same length, without sacrificing any of the necessary conductivity, and being practically non-corrosive, the insulated coating is not damaged by rust, which rapidly destroys the covering of iron wires exposed to the weather.

For line wires running through trees, and liable to contact with other wires or means of escape for the current, these wires will commend themselves to practical electrical engineers, and their low cost, conductivity considered, will place them within their reach for many purposes, where other wires have heretofore been used.

H. C. LÜDERS.

ST. LOUIS, Oct. 22, 1883.

The Shultz Belting Co., James Garnett, Manager, 140 *N. Third street, Philadelphia.*

GENTLEMEN.—We desire to express to you our opinion of your belts, made for us and now in use at our lighting station in this city.

We have in our varied experience used all, or nearly all, kinds of belts, and have never found one that would give us the satisfaction which your belt has done.

We need in our business a perfect transmission of power, no slipping of belts, either caused by rivets or looseness can be allowed; with your belts we have had nothing of the kind.

To illustrate, some four months ago we purchased a belt and had it made endless, and placed it on a machine connecting straight with engine, that belt has been running ever since, in use every day, and all the tightening we have done is to pull the machine back from the engine one inch.

Our experience with your other belts is just the same. We should be most happy for you to refer any one to us for reference, as to the excellence of your belts for running electric lighting apparatus.

Respectfully,
BRUSH ELECTRIC ASSOCIATION,
by W L. B G Allen,
Secretary.

REVIEWS.

PRACTICAL ELECTRICAL UNITS POPULARLY EXPLAINED; by James Swinburne. 61 pp. 16mo. London and New York: E. & F. N. Spon

When electric lighting began to be an industry, some of the leading companies were obliged to embody in their instructions much electrical information of a general nature, because there was no published book containing the desired elements of instruction which were essential to many of their subordinates. This little book is adapted to just such a field. The author essays the difficult task of giving definitions, and succeeds in such a perfect manner, that one is inclined to wish that the book had been projected on a somewhat wider scope.

In the next edition we trust to see tables of equivalents of mechanical and electrical energy, similar to the one in our issue of last April.

ELECTRICITY AS A MOTIVE POWER; by Count Th. Du Moncel, and Frank Geraldy. Translated and edited with additions by C. J. Wharton. 316 pp. 8vo. E. & F. N. Spon, London and New York

This last volume, from the pen of this eminent electrician, is a work which will prove of value to the numerous persons engaged upon the problem of the transmission of electricity and its conversion into work. Those who have not given attention to the question of electro-motors, have little conception of the difficulties which beset the problem of converting electricity into work. In the one item of precedents furnished by the description of all the known types of motors, this book will prove of utility to those who are dealing with the subject of electro-motors.

Passing by the introduction, which glorifies the subject in a manner well suited to catch the ear of a "popular science" reader, the question of electro-magnets is treated in a very able manner. The illustrations showing various forms of electro-magnets, furnish suggestions of means to overcome the difficulties frequently arising in designing electrical apparatus The laws governing the construction and operation of electro-magnets, as given at length in a small book on the subject by the same author, about a year ago, are here stated in a few clear and condensed pages.

One difficulty in the earlier electro-motors, and which is common to all apparatus using electro-magnets, is the rapidity with which the strength of the magnetic field decreases as the armature is withdrawn from the magnet.

Several devices are illustrated which are made for the purpose of converting the varying magnetic force into uniform work One of them, Fig. 27, by Houdin and Froment, shows a pair of levers in juxtaposition by a rolling contact. The armature pulls the end of one lever and as its position changes, the leverage varies inversly in the proportion of the square of the distance which the armature moves. The curved sides of these levers are either ellipses with the fulcra of the levers at the foci, or one of the spirals, although the author makes no reference to the matter. As an illustration of how similar devices may be independently re-invented, many years ago, we saw in one of the Mechanics' Fairs, in Boston, a pair of scales invented by a man named Shaw, wherein weights placed on the scales were indicated on a dial as in a spring scale, only the weight was transmitted to the dial through a pair of curved levers like those cited in this book. The exhibitor had produced the curves (ellipses) by actual trial, and innocently related the difficulties experienced in trying to find a patent solicitor who could describe the "kind of a circle" used on his invention. The expense of the scales probably restrained their introduction.

Froment's method of distributing the magnetic force is by means of a toggle joint, and, therefore, crudely approximate.

Methods of lengthening the attractive force of a magnet by shaping the poles in cores (Pellis and Henrys), and wedges (Froment) are shown; but it is a matter of surprise that the author did not cite the method successfully used by Professors Thomson and Houston in this country, to render the attractive force of a magnet either uniform or variable in any desired ratio by terminating the poles in paraboloids (approximately), and allowing them to extend through holes in the armatures.

We do not see anything upon the subject relative to the ratio between the length of a magnet, and the position of a centre of magnetic intensity.

The subject of the historical motors begins with that of Jacobi, 1834–1838, and subsequent to 1844, the early motors are classed under four heads: First, those depending upon solenoids; second, electro-magnets; third, those in which gravity is used; fourth, electro chemical motors. Then the question of the reversible motors, or those on the principle of the revolving armature, which began in the revolving bobbins of Pixii, and developed by later inventors into the various types of armatures used in all dynamo machines.

Many instances are given of the uses of electro-motors for propelling boats, locomotives, carrying packages, tricyles, playing piano (hope it won't work) lifting water, sewing machines and passenger elevators.

Upon the important problem of the regulation of electro-motors, the author unfortunately gives no light, save a clear statement of the principles involved, but for the good reason that no inventor has as yet produced an electro-motor which can be governed under varying conditions of load, with an economy and efficiency comparable to the limits of regulation demanded of steam engines and water wheels.

The translator has performed his part in an admirable manner, rendering the French text of the author into pure English, free from foreign idiom.

We commend the book to our readers as being the latest exposition of the state of the art of electro-motors, and full of information for all interested in electricity.

WORKSHOP RECEIPTS; (second series), by Robert Haldane. 485 pp. 12mo. London and New York: E. & F. N. Spon.

A work of much use to those engaged in the chemical trades, rather than to the place in the laboratory, where even the great industrial cyclopædias are sometimes insufficient.

In compiling the work from various authorities, the editor followed the units used by the several writers, and as a consequence, English and metric weights and measures jostle in odd confusion. This is especially noticeable in the various captions under the head of "alcohol." In this connection, "wood alcohol" is not described among other varieties of alcohol, but is after "rectification of alcohol."

A good example of the latest information is in the condensed account of research relative to "Baking Powders," while the varieties of compounds embraced under the head of "Bitters," impels one to turn back to the fly-leaf to learn whether this be "The True Bartender's Guide."

American precedents are frequently overlooked. Under the head of cleansing, naptha is overlooked. The receipts for ices, give directions for freezing them after the manner of the last generation, omitting all reference to the ingenious ice-cream freezers, which abound wherever the Yankee trades his wares.

The book contains a large amount of information which is held only in books alike expensive and rare. Its convenient use is materially assisted by a satisfactory index.

The volume is a model of good typography for a work of this class; the press-work being very creditable.

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287,618 Electric Alarms, Circuit Closer for. L. A. Brigel, Cincinnati, Ohio.
287,641 Electric Battery. A. F. Delafield, New York, N. Y.
287,533 Electric Circuits, Safety Catch for. C. Goddard, New York, N. Y.
287,516 Electric Distribution, System of. T. A. Edison, Menlo Park, N. J.
287,608 Electric Generator, Dynamo or Magnetic. F. Bain, Chicago, Ill.
287,654 Electric Lighting Systems, Indicator for. W. P. Freeman, Brooklyn, N. Y.
287,609 Electric Machine, Dynamo. F. Bain, Chicago, Ill.
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287,521 Electric Machine, Dynamo or Magneto. T. A. Edison, Menlo Park, N. J.
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287,774 Electric Machine, Dynamo or Magneto. P. P. Nungesser, Cleveland, Ohio.
287,524 Electric Machine, Regulator, Dynamo. T. A. Edison, Menlo Park, N. J.
287,565 Electric Machine Regulator, Dynamo. G. I. Murdock, Binghamton, N. Y.
287,678 Electric Machine, Wiper for the Commutators of Dynamo. Alpena, Mich.
287,511 Electric Regulator. T. A. Edison, Menlo Park, N. J.
287,532 Electric Conductors, Junction for. C. Goddard, New York, N. Y.
287,525 Electrical Distribution, Regulator for Systems of. T. A. Edison and C. L. Clarke, Menlo Park, N J.
287,515 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
287,517 Electrical Distribution, System of. T. A. Edison, Menlo Park, N. J.
287,501 Electrical Testing. C. J Bradley, New York, N. Y.
287,664 Fire Alarm Apparatus, Electric. W. C. Gordon, England.
287,758 Flat Iron, Electric, R. N. Dyer, and. N. W. Seely, Menlo Park, N. J.
287,766 Insulated Electric Conductor. G. W. McGill, New York, N. Y.
287,776 Insulated Electric Conductor. H. O. Phillips, Waterbury, Conn.
287,519 Lamp, Incandescing Electric. T. A. Edison, Menlo Park, N. J.
287,520 Lamps, Incandescing Conductor for Electric. T. A. Edison, Menlo Park, N. J.
287,518 Lamps, Manufacturing Incandescing Electric. T. A. Edison, Menlo Park, N. J.
287,773 Magneto Electric Machine. P. P. Nungesser, Cleveland, Ohio.
287,446 Railway Signal, Electric. W. W. Le Grande, Louisville, Ky.
287,466 Railway Signals, Electrical Connection for. T. J. Pottenger, Louisville, Ky.
287,742 Telephone Receiver. H. E. W ite, New York, N. Y.
287,743 Telephone Receiver. H. E. Waite, and S. H. Bartlett, New York, N. Y.
287,710 Telephone Time Signal Repeating System. J. M. Oram, Dallas, Texas.
287,490 Telephone Transmitter. E. L. Wilson, Boston, Mass.
287,449 Telephonic Repeater and Relay. J. A. Maloney, Washington, D. C.
287,401 Time Detector, Electric. T. Ahearn, Ottawa, Ontario.
287,775 Time Lock, Electric. W. E. Peirce, Newark, N. J.

NOVEMBER 6th.

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288,175 Clock Systems, Circuit and Apparatus for Electric. Jas. Hamblett, Brooklyn, N. Y.
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287,800 Dynamometer, Electro-magnetic. C. F. Bracket, Princeton, N. J.
10,401 Electric Cables, Machine for Making. J. Farrell, (Re-issue).
10,402 Electric Cables, Machine for Making. J. Farrell, (Re-issue).
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288,183 Telephone Support. C. H. Ohly, Sandusky, Ohio.
288,017 Telephonic Transmitter. H. Clay, Philadelphia, Pa.
288,157 Voltaic-arc Light. W. Baxter, Jr., Jersey City, N. J.

NOVEMBER 13th.

288,570 Annunciator and Fire Alarm, Electric Hotel. A. T. Hess, Des Moines, Iowa.
288,202 Bell, Polarized Electric. W. J. Bowen, Norwalk, Ohio.
288,496 Clock, Electric. L. P. Schlaefli, Soleure Switzerland.
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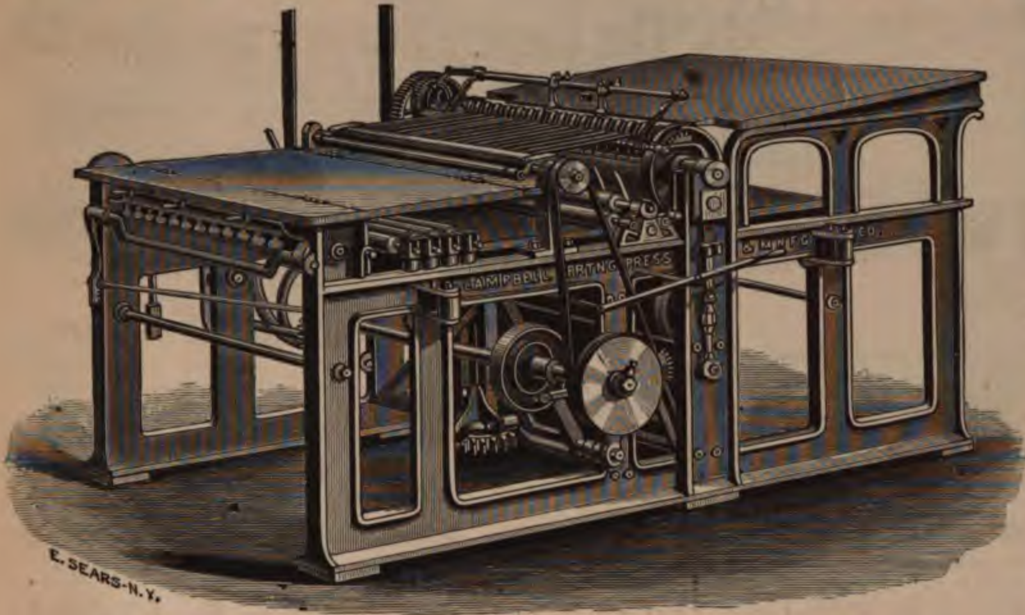

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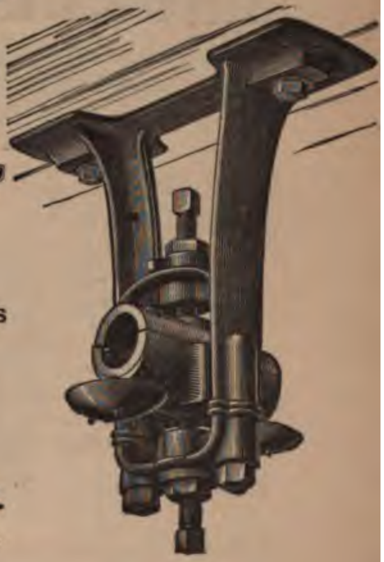

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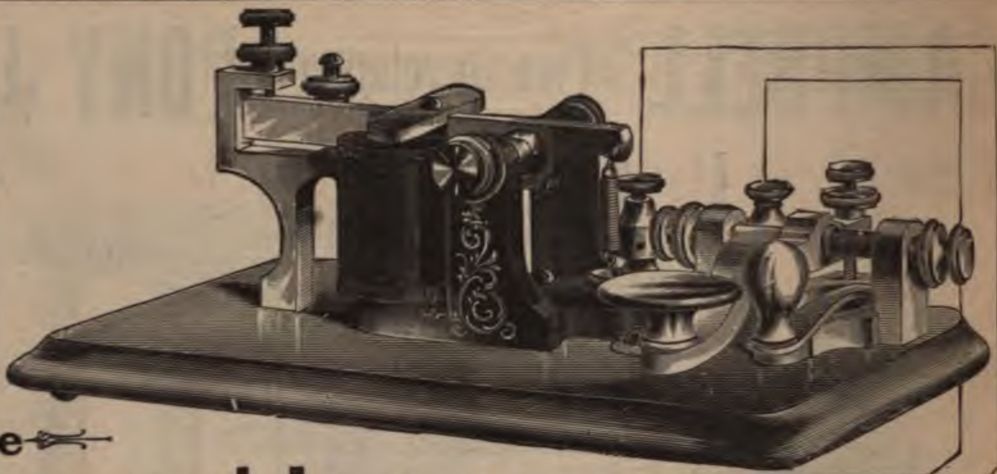

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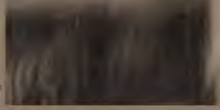

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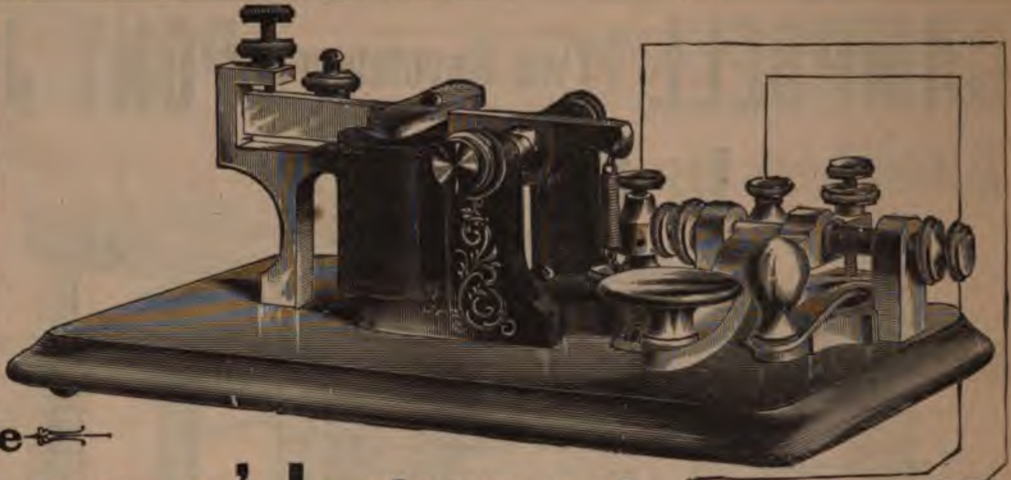

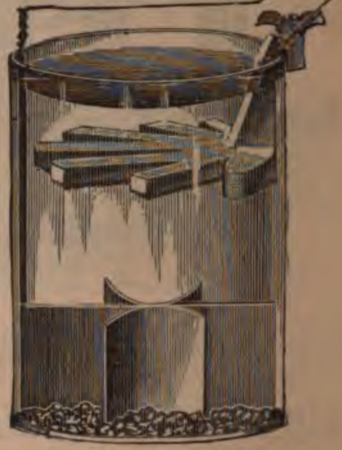

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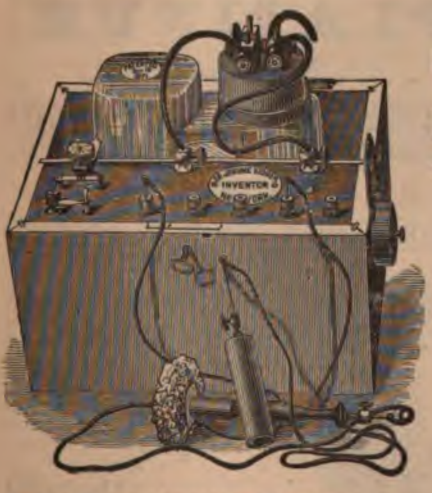

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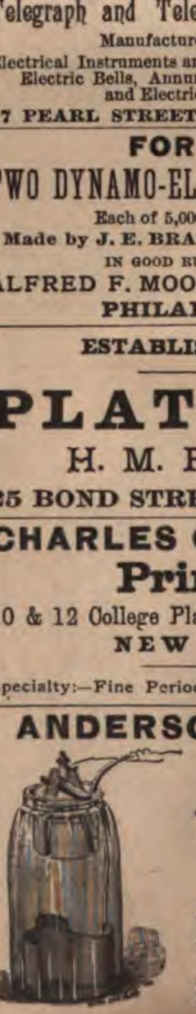

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